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3/25/02

ATTACHMENT 1

TO UNILATERAL ADMINISTRATIVE ORDER FOR REMEDIAL DESIGN AND REMEDIAL ACTION

Docket No. CERCLA 10-2002-0064

MOUTH OF HYLEBOS WATERWAY PROBLEM AREA
COMMENCEMENT BAY NEARSHORE/TIDEFLATS SUPERFUND SITE
TACOMA, WASHINGTON

U.S. Environmental Protection Agency
Region 10
Seattle, Washington

Commencement Bay Nearshore/Tideflats
RECORD OF DECISION

September 1989

PREFACE

This Record of Decision documents the remedial action plan for contaminated sediments and associated sources within eight discrete problem areas at the Commencement Bay Nearshore/Tideflats site. The Record of Decision serves three functions:

- It certifies that the remedy selection process was carried out in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act as amended by the Superfund Amendment and Reauthorization Act, and to the extent practicable, with the National Contingency Plan.
- It summarizes the technical parameters of the remedy, specifying the treatment, engineering, and institutional components, as well as remediation goals.
- It provides the public with a consolidated source of information about the site, the selected remedy, and the rationale behind the selection.

In addition, the Record of Decision provides the framework for transition into the next phases of the remedial process, Remedial Design and Remedial Action.

The Record of Decision consists of three basic components: a Declaration, a Decision Summary, and a Responsiveness Summary. The Declaration functions as an abstract for the key information contained in the Record of Decision and is signed by the U.S. Environmental Protection Agency Regional Administrator. The Decision Summary provides an overview of the site characteristics, the alternatives evaluated, and an analysis of those options. The Decision Summary also identifies the selected remedy and explains how the remedy fulfills statutory requirements. The Responsiveness Summary addresses public comments received on the Proposed Plan, the Feasibility Study, and other information in the administrative record.

This Record of Decision is organized into three main sections: the Declaration, the Decision Summary, and Appendices. Appendix A provides letters of concurrence from the state of Washington and the Puyallup Tribe of Indians, Appendix B consists of the Responsiveness Summary, and Appendix C presents implementation schedules for source- and sediment-related remedial activities in the eight problem areas addressed in this Record of Decision.

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LIST OF ACRONYMS

Acronym	Definition
AAL	Acceptable ambient level
ADI	Acceptable daily intake
AET	Apparent effects threshold
AKARTs	All known available and reasonable methods of treatment
ARAR	Applicable or relevant and appropriate requirement
CB/NT	Commencement Bay Nearshore/Tideflats
CB/STC	Commencement Bay South Tacoma Channel
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
Corps	U.S. Army Corps of Engineers
EAR	Elevation above reference
Ecology	Washington Department of Ecology
EPA	U.S. Environmental Protection Agency
HPAH	High molecular weight polycyclic aromatic hydrocarbon
LPAH	Low molecular weight polycyclic aromatic hydrocarbon
MCL	Maximum contaminant level
NCP	National Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
POTW	Publicly owned treatment works
PRP	Potentially responsible party
PSDDA	Puget Sound Dredged Disposal Analysis
PSWQA	Puget Sound Water Quality Authority
RCRA	Resource Conservation and Recovery Act of 1976
SARA	Superfund Amendments and Reauthorization Act of 1986
SEDCAM	Sediment Contamination Assessment Model
TBC	Other factors to be considered
TPCHD	Tacoma-Pierce County Health Department
UBAT	Urban Bay Action Team

DECLARATION

COMMENCEMENT BAY NEARSHORE/TIDEFLATS
TACOMA, PIERCE COUNTY, WASHINGTON
RECORD OF DECISION

Statutory Preference for Treatment as a Principal
Element Is Not Met and Five-Year
Site Review Is Required.

SITE NAME AND LOCATION

Commencement Bay Nearshore/Tideflats
Tacoma, Washington

STATEMENT OF PURPOSE

This decision document presents the selected remedial action for two of the six operable units of the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund site in Tacoma, Washington, developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Contingency Plan (NCP). This Record of Decision is based on the administrative record for this site.

The state of Washington and the Puyallup Tribe of Indians (whose reservation is largely within or adjacent to the site) concur on the selected remedy (see Appendix A).

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not corrected by implementation of response actions selected in this Record of Decision, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

The remedy selected in this Record of Decision covers two CB/NT operable units, source control (Operable Unit 05) and sediment remediation (Operable Unit 01), which were formerly referred to as a combined operable unit, *Areawide*. The function of the comprehensive remedy for these two operable units is to protect the marine environment and thereby reduce associated public health concerns.

In the *Commencement Bay Nearshore/Tideflats Feasibility Study* (Tetra Tech 1988a), which covered the former operable unit *Areawide*, nine problem areas were identified that warranted source control and sediment remediation:

- Head of Hylebos Waterway
- Mouth of Hylebos Waterway
- Sitcum Waterway
- St. Paul Waterway
- Middle Waterway
- Head of City Waterway
- Wheeler-Osgood Waterway
- Mouth of City Waterway
- Ruston-Pt. Defiance Shoreline.

Response actions governed by this Record of Decision are limited to eight of the nine CB/NT problem areas listed above. As a result of new information received during public comment on the CB/NT feasibility study, the U.S. Environmental Protection Agency (EPA) has decided to reconsider the proposed plan for the Ruston-Pt. Defiance Shoreline problem area. A revised feasibility study for that problem area, now established as Operable Unit 06 (ASARCO Sediments) is currently being prepared by EPA for further public comment.

The selected remedy for the eight remaining CB/NT problem areas is defined according to cleanup objectives for both source control and sediment remediation. The remedy establishes a cleanup objective and a multi-element remedial strategy designed to achieve the objective. In general, the selected remedy will be implemented in each of the different problem areas independently of one another. The overall remedy includes a 8-year active cleanup phase for source control and sediment remediation, and a 10-year natural recovery phase.

Remedial technologies for source control, the first step in the selected remedy, include a full range of all known available and reasonable methods of treatment (AKARTs). The schedule for source control varies among problem areas but is expected to be largely accomplished during the next 8 years. The Washington Department of Ecology (Ecology) is the lead management agency for source control under a cooperative agreement with EPA.

The second step in the selected remedy, correction of sediment problems, will be accomplished through a combination of natural recovery and active sediment remediation. Areas expected to recover naturally within a 10-year period after source control measures are implemented will be monitored annually to confirm that prediction. Site use restrictions, such as advisories against seafood consumption, will be implemented to protect human health until recovery is complete. Areas not expected to recover naturally in a timely manner will be actively remediated when source control measures are designated acceptable by Ecology and EPA.

Active remediation of problem sediments will be accomplished by utilizing a limited range of four confinement technologies, each of which can provide a feasible and cost-effective means of achieving the cleanup objective for the site. These technologies are in-place capping, confined aquatic disposal, nearshore disposal, and upland disposal. The selected remedy provides performance objectives for each of these confinement technologies and allows the flexibility to implement any or all of them during the active cleanup phase of the project. EPA will be the lead agency for implementing sediment remediation. The Puyallup Tribe of Indians has been established as a supporting agency for the project through a cooperative agreement with EPA.

DECLARATION

The selected remedy is protective of the marine environment and related human health concerns. The remedy also complies with federal, state, and tribal requirements that are applicable or relevant and appropriate for this remedial action, and it is cost-effective. This remedy uses permanent solutions and alternative treatment technologies to the maximum extent practicable for this site. The feasibility of permanent treatment will be evaluated on a case-by-case basis by Ecology for the purposes of source control. However, treatment of contaminated marine sediments was not judged practicable at this site because CB/NT problem sediments are characterized by relatively low concentrations of contaminants and relatively large volumes of material. Therefore, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy.

Because this remedy will result in hazardous substances remaining onsite in concentrations above health-based and environmentally-based cleanup levels, a review will be conducted within 5 years after remedial action begins to assure that the remedy continues to provide adequate protection of human health and the environment. The timeframe for the 5-year review will be determined separately for source control and sediment remediation and will vary among the eight problem areas. Initiation of the 5-year review period will be scheduled by the lead management agency for each action.

30 September 1989
Date

Robie G. Russell
Regional Administrator
U.S. Environmental Protection Agency
Region 10

DECISION SUMMARY

1. OVERVIEW

The Decision Summary provides a condensed description of the site-specific factors and analysis that led to selection of the remedy for the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund site, beginning with the early identification and characterization of the problem (documented in the remedial investigation), proceeding through the identification and evaluation of candidate remedial alternatives (documented in the feasibility study), and concluding with the remedy selected in this Record of Decision. The involvement of the public throughout the process is also described, along with the environmental programs and regulations that relate to or direct the overall site remedy. The way in which the selected remedy meets CERCLA requirements is also carefully documented.

The Decision Summary is provided in the following sections. Section 2 describes general characteristics of the site. Section 3 provides site history and discusses the coordination of enforcement activities. Community participation is highlighted in Section 4. The scope of the response actions is described in the context of the overall site strategy in Section 5. Site characteristics and a summary of site risks are provided in Sections 6 and 7, respectively. Candidate alternatives are described and compared in Sections 8 and 9, respectively, and the selected remedy is presented in Section 10. The conformance of the selected remedy with statutory requirements is described in Section 11, and significant changes between the remedy described in the proposed plan and the remedy selected in the Record of Decision are described in Section 12.

2. SITE LOCATION AND DESCRIPTION

2.1 SITE LOCATION

The CB/NT Superfund site is located in Tacoma, Washington at the southern end of the main basin of Puget Sound (Figure 1). The site encompasses an active commercial seaport and includes 10-12 square miles of shallow water, shoreline, and adjacent land, most of which is highly developed and industrialized. The upland boundaries of the site are defined according to the contours of localized drainage basins that flow into the marine waters. The marine boundary of the site is limited to the shoreline, intertidal areas, bottom sediments, and water of depths less than 60 feet below mean lower low water. The nearshore portion of the site is defined as the area along the Ruston shoreline from the mouth of City Waterway to Pt. Defiance. The tideflats portion of the site includes the Hylebos, Blair, Sitcum, Milwaukee, St. Paul, Middle, Wheeler-Osgood, and City waterways; the Puyallup River upstream to the Interstate-5 bridge; and the adjacent land areas. Because the landward boundary of the CB/NT site is defined by drainage pathways rather than political boundaries, the precise landward extent of the site may be adjusted as new information regarding surface water and groundwater flow patterns is developed.

2.2 CURRENT LAND USE

The CB/NT site is located within the city of Tacoma, which has a population of 162,100. The land, water, and shoreline within the study area are owned by various parties, including the state of Washington, the Port of Tacoma, the city of Tacoma, Pierce County, the Puyallup Tribe of Indians, and numerous private entities. Much of the publicly owned land is leased to private enterprises. Within the site boundaries, land use is chiefly industrial and commercial.

The Port of Tacoma owns approximately 35-40 percent of the 2,700 acres that make up the port and industrial areas within the CB/NT site. The port operates many cargo handling and storage facilities along the waterways and leases other properties to large and small industrial, manufacturing, and commercial tenants. Many of the remaining properties within the port and industrial area were under port ownership at one time, but have since been sold. Major private landowners include lumber, chemical, and petroleum companies. Property along the Hylebos Waterway is owned almost exclusively by private companies, and there are several privately-owned parcels along the Blair Waterway. Other privately owned parcels are found predominantly at the landward end of the port and industrial area.

A large portion of the tideland and offshore areas of the CB/NT site is either owned outright by the state or is designated as state-owned harbor areas. The Port of Tacoma owns tidelands and bottom sediments in several areas including the head of Hylebos Waterway, the head of Blair Waterway, and Milwaukee and Sitcum waterways. The St. Paul and Wheeler-Osgood waterways are privately owned. Private ownership of shorelines and intertidal areas in many portions of the site generally corresponds with ownership of the adjacent upland property parcels.

The Puyallup Tribe of Indians has asserted title to land in the Tacoma tideflats area, including former Puyallup River bottomland and filled tidelands adjacent to the Puyallup Reservation. Negotiations among the Puyallup Tribe of Indians, the federal government, the state of Washington, the Port of Tacoma, and other affected parties were completed during the summer of 1988 to resolve various land ownership issues. The settlement agreement was approved on 27 August 1988 by tribal members and by federal, state, and local governments. On 21 June 1989, the Puyallup Tribe of Indians Settlement Act of 1989 was signed into law by the President, incorporating the August 1988 settlement agreement and technical documents. Efforts are underway to implement the terms of the agreement, which adds to the tribe's land base and provides for substantial restoration and enhancement of fisheries resources. Several large parcels of property within the

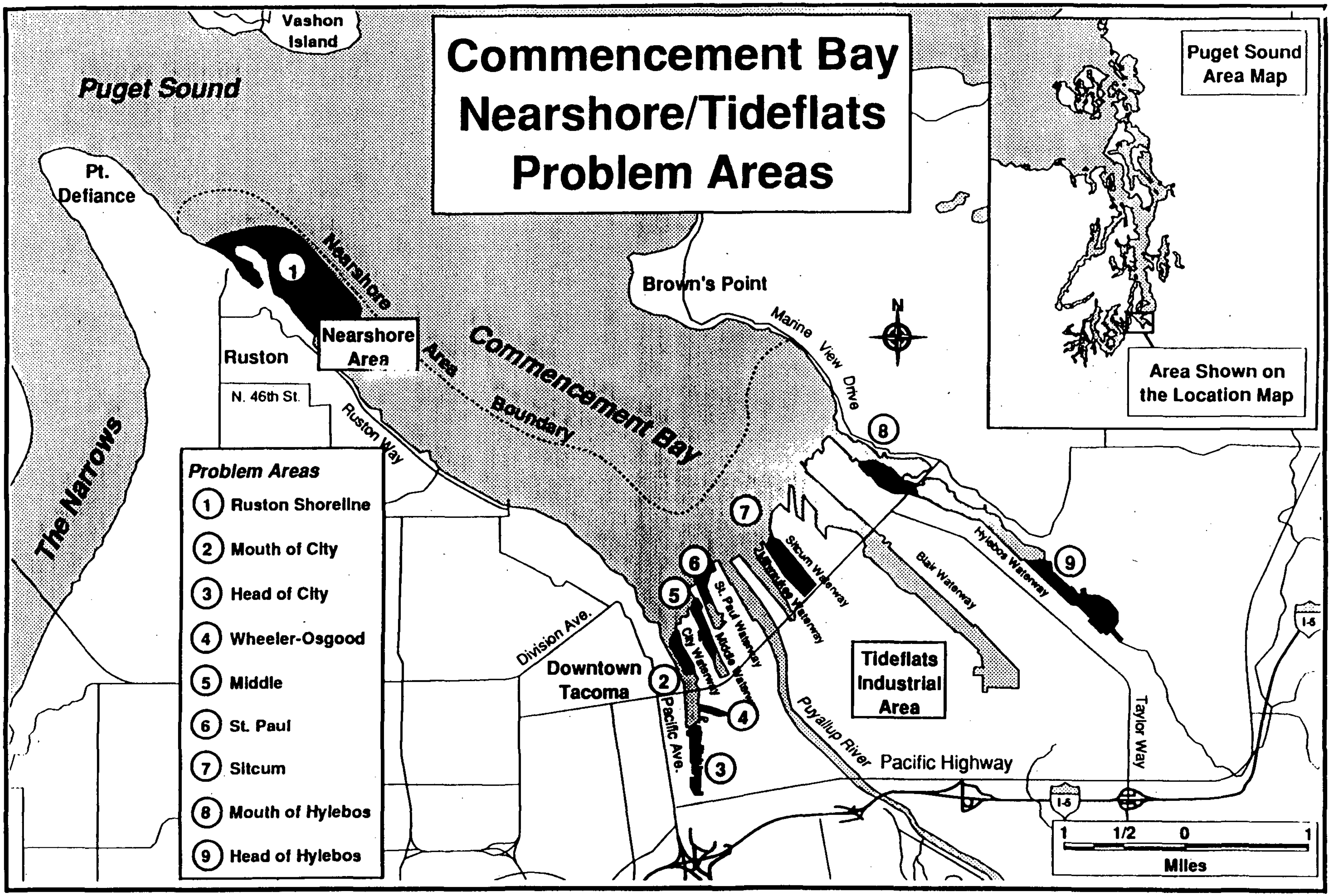


Figure 1. Commencement Bay Nearshore/Tideflats study area

CB/NT site boundaries that are slated for environmental cleanup by the Port of Tacoma will be transferred to the tribe within the next few years.

Contaminants in the CB/NT area originate from both point and nonpoint sources. Industrial surveys conducted by the Tacoma-Pierce County Health Department (TPCHD) and the Port of Tacoma indicate that there are more than 281 active industrial facilities in the CB/NT area. Approximately 34 of these facilities are National Pollutant Discharge Elimination System (NPDES)-permitted dischargers, including two sewage treatment plants. Nonpoint sources include two creeks; the Puyallup River; numerous storm drains, seeps, and open channels; groundwater seepage; atmospheric deposition; and spills. The TPCHD has identified approximately 480 point and nonpoint sources that empty into Commencement Bay (Rogers et al. 1983).

2.3 ENVIRONMENTAL SETTING

Commencement Bay is a large, deepwater embayment of approximately 9 square miles in southern Puget Sound. In March 1987 Puget Sound was designated by EPA as an estuary of national significance. Several waterways including the Puyallup River adjoin Commencement Bay. The drainage area for the Puyallup River is approximately 950 square miles.

Commencement Bay, including the CB/NT site, supports important fishery resources. Four salmonid species (chinook, coho, chum, and pink) and steelhead trout occupy the bay for part of their life cycle. Recreational and commercial harvesting of these species occurs in the bay. Extensive inshore marine fish resources include English sole, rock sole, flathead sole, c-o sole, sand sole, starry flounder, and speckled sand dab. Rock sole, c-o sole, and several species of rockfish are most abundant along the outer shoreline. Although the TPCHD has warned against regularly consuming fish, shellfish, and crabs caught within the study area, recreational harvesting of many of these species occurs, primarily within City Waterway and along the Ruston-Pt. Defiance Shoreline.

2.4 PROBLEM DEFINITION

The CB/NT remedial investigation/feasibility study and selection of remedy have been conducted in accordance with CERCLA as amended by SARA, commonly known as Superfund. However, given the large study area, the multiplicity of contaminant sources, and the diversity of ongoing activities within the CB/NT site, project development and selection of remedy has differed in many respects from the reports and implementation strategies developed at more traditional Superfund sites. There are five key aspects of this project that are unique:

- The focus on protection of the marine environment and public health concerns related to the marine environment
- The relationship of the project with other federal, state, tribal, and local programs and authorities
- The development of sediment quality objectives that address a diverse range of chemical contaminants
- The overall scope of the problem, including a very large volume of sediment requiring remediation
- The need for additional data in the remedial design phase to refine and implement the remedy.

2.4.1 Focus on Marine Environment

This Record of Decision is intended only to guide actions related to the goals and objectives of the CB/NT Superfund project. The CB/NT Superfund project focuses on contaminated marine sediments, contaminant sources, impacts to marine organisms, and related human exposure pathways. Therefore, although the CB/NT site includes a large and active urban embayment, response actions governed by this Record of Decision are designed to address specific problems associated either with the marine environment or with public health concerns related to the marine environment. The CB/NT Superfund project is not intended to address other types of environmental or public health problems within the site boundaries that should be adequately covered by other federal, state, tribal, or local programs. Problems not within the scope of the CB/NT project include contaminated properties and sources of contamination within the site boundaries that have not been determined to impact marine sediments.

CB/NT response actions are further focused by this Record of Decision to address specific problem areas within the overall site boundaries. As described in Section 3.4, the identification of potentially responsible parties (PRPs) by EPA will also focus on owners and operators of businesses and properties associated with contaminated sediments within the eight specific problem areas addressed by this Record of Decision.

2.4.2 Relation to Other Environmental Programs and Activities

Numerous local, state, and regional programs developed during the course of the CB/NT project are similarly focused on the protection of marine resources and management of marine sediments, as described in the next section. The attainment of CB/NT cleanup objectives under the Superfund program will require effective coordination with these and other environmental and public health programs. Jurisdictional considerations will be important during project implementation in order to differentiate Superfund-related activities from activities regulated according to other programs and authorities.

Correction of sediment contamination problems throughout the CB/NT site will be accomplished through a combination of activities implemented under both Superfund and non-Superfund authorities, including:

- Site use restrictions (e.g., public warnings and fisheries advisories to reduce potential human exposure) implemented by state and local health authorities
- Source control measures to reduce or eliminate ongoing releases of hazardous substances implemented through the following authorities:
  - Wastewater discharges regulated under state and federal water quality laws
  - Stormwater and industrial pretreatment requirements implemented under federal, state, and local laws and regulations
  - Ecology's Commencement Bay Urban Bay Action Team (UBAT) oversight and enforcement of source control measures
- Natural recovery through chemical degradation, deposition of clean sediments, and diffusive loss of contaminants to overlying water
- Sediment remedial actions for more significantly contaminated sediments using appropriate confinement technologies (e.g., removal, capping, disposal) conducted under the federal Superfund law.

The effective integration of the key project elements, related activities, and environmental authorities described above will be critical in the ultimate attainment of CB/NT cleanup objectives.

2.4.3 Definition of Cleanup Goals

The CB/NT project was further complicated by the lack of promulgated sediment standards to serve as project cleanup objectives. Because of the focus on the marine environment, the development of cleanup objectives for the project had a similar emphasis on environmental risk assessment methods. As described in Section 7.2, these methods utilize a preponderance-of-evidence approach that is based on a suite of three biological indicators. The cleanup objectives are further adjusted to be protective of related human health concerns (see Section 7.1). In both cases, cleanup levels have been established in relation to reference area conditions. Management of site risks was based on the assumption that it would be infeasible to establish sediment cleanup objectives for the CB/NT site that were cleaner than reference areas.

Initially, the attempt to develop definitive cleanup objectives for the CB/NT site was complicated by the almost complete lack of definitive standards, guidelines, or criteria for defining acceptable levels of contaminants in marine sediments. However, the *1989 Puget Sound Water Quality Management Plan* (PSWQA 1988) specified numerous goals and policies applicable to the CB/NT area. For purposes of defining sediment cleanup goals and requirements, two program elements of the PSWQA plan are of particular importance: standards for classifying sediments having adverse effects (Element P-2) and guidelines for sediment cleanup decisions (Element S-7).

Element P-2 requires Ecology to develop and adopt regulatory standards for identifying and designating sediments that have observable acute or chronic adverse effects on biological resources or pose a significant health risk to humans. The standards for defining "sediments that have acute or chronic adverse effects" may incorporate chemical, physical, or biological tests and must clearly define interpretive guidelines. Initial standards may exclusively address biological effects, but shall be revised to include human health concerns as pertinent information becomes available. The standards are to be used to assess discharges through NPDES (Element P-7), stormwater (Element SW-4), and nonpoint programs; to identify sites with sediment contamination (Element S-8); and to limit the disposal of dredged material (Element S-4).

Element S-7 requires Ecology to develop guidelines for determining when to implement sediment remedial action. The guidelines will consider regulatory deadlines for making decisions, natural recovery periods for sediments, procedures for determining priorities for action (including consideration of costs), and trigger levels for defining sediments that require expedited remedial action. Sediment remedial action trigger levels may be higher than the standards developed under Element P-2.

The sediment quality goal of Element P-2 was adopted as the long-term sediment quality goal for the CB/NT site. As in other parts of Puget Sound, this sediment quality goal is meant to establish levels of sediment contamination that would be acceptable throughout the CB/NT area. It is a long-term goal to be achieved through numerous actions over a period of years. The factors associated with translating this goal into project cleanup objectives will vary depending on the type of action needed, statutory requirements, and site-specific considerations.

In accordance with the focus of the CB/NT project and the goals of the 1989 PSWQA plan, cleanup objectives were developed for the project according to the following parameters:

- **Sediment Quality Goal**: The sediment quality goal is a conceptual target condition for Puget Sound, defined by Element P-2 of the 1989 PSWQA plan as the absence of acute or chronic adverse effects on biological resources or significant human health risk.
- **Sediment Quality Objective:** The sediment quality objective is a discrete and measurable target for project cleanup related to the Puget Sound goal. The objective is measurable in terms of specific human health risk assessments and environmental effects tests, and associated interpretive guidelines. The resulting biological effect levels or chemical concentrations are scientifically acceptable definitions of the sediment quality goal using available information.
- **Sediment Remedial Action Level**: The sediment remedial action level differentiates areas that exceed the sediment quality objective, but are predicted to recover naturally, from those that are more significantly contaminated and therefore require active remediation to achieve the sediment quality objective. The intent of any

active remediation of sediments is to achieve a net environmental and public health benefit and therefore requires consideration of habitat issues.

- **Source Control Level:** The goals and objectives of source control are defined as targets that will achieve respective sediment goals and objectives. Source control will be implemented according to applicable or relevant and appropriate requirements (ARARs) and AKARTs. Compliance with the sediment quality objective will be confirmed through monitoring.

2.4.4 Problem Scope

The development of a comprehensive remedy for CB/NT site is complicated by various site characteristics. The broad geographic area includes various sources, contaminants, and associated biological effects and human health risks. Remediation of sediment contamination is inherently complex because 1) the concentration of habitat and food sources at the sediment-water interface create conditions that are sensitive to contaminant accumulation, 2) contaminants that accumulate in sediments are generally dispersed from their sources, resulting in relatively large areas of low-level contamination, 3) surface sediment contamination reflects both historical and on-going contamination because sediment accumulation is a relatively slow process (e.g., CB/NT sediments typically accumulate at rates from 0.2 cm/yr to 2 cm/yr) and sediment reworking and benthic activity mix sediment over the upper 5-15 cm, and 4) the relatively large volumes of sediments requiring remediation present considerable problems regarding disposal site availability and capacity.

To effectively deal with the broad geographic area and multiplicity of sources, high priority problem areas were identified and treated independently of one another. Source control and cleanup are being implemented on an individual basis, but subsequent sediment remediation will be conducted as a concerted effort in each problem area by multiple and diverse PRPs. The remedies developed for individual problem areas also require that various types of activities (i.e., use restrictions, source control, remedial action and natural recovery, and monitoring) be implemented in an integrated fashion.

2.4.5 Data Needs in the Remedial Design Phase

The data collection efforts in the remedial investigation/feasibility study were designed to characterize contamination problems, identify priority areas requiring remediation, and evaluate remedial alternatives. The data analyzed in the remedial investigation/feasibility study were not adequate to fully determine the effectiveness of source controls previously implemented or to fully define the volume of sediment exceeding the cleanup objective. Therefore, information developed during sediment remedial design and future source monitoring plays a key role in the refinement of the selected remedy for many problem areas. Details of the timing and purpose of major phases of source and sediment monitoring are provided in Section 10. Furthermore, several source control actions have been implemented since the source loading analysis was conducted. Data gaps associated with sources will be addressed under the source control programs directed by Ecology. While source control programs address many aspects of source-related contamination, actions that diminish impacts on sediment are the central focus of the CB/NT Superfund project. Consequently, source loading data (i.e., on the amount of each contaminant discharged to each of the problem areas) provide the most important information for determining the effectiveness of source controls, the relative contributions of problem chemicals by ongoing sources, and the need for additional source controls.

3. SITE HISTORY AND ENFORCEMENT

This section presents a synopsis of the history of industrial development and CERCLA actions at the CB/NT site, and provides an overview of CERCLA and non-CERCLA enforcement tools available for implementing remedial actions.

3.1 SITE HISTORY

At the time of urban and industrial development in the late 1800s, the south end of Commencement Bay was composed largely of tideflats formed by the Puyallup River delta. Dredge and fill activities have significantly altered the estuarine nature of the bay since the 1920s. Intertidal areas were covered and meandering streams and rivers were channelized (Figure 2). Numerous industrial and commercial operations have located in the filled areas of the bay, including shipbuilding, chemical manufacturing, ore smelting, oil refining, food preserving, and transportation facilities.

With industrialization, the release of hazardous substances and waste materials into the environment has resulted in alterations to the chemical quality of waters and sediments in many areas of the bay. Contaminants found in the area include arsenic, lead, zinc, cadmium, copper, mercury, and various organic compounds such as polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs).

Commencement Bay was placed on a national interim list of 115 highest priority hazardous waste sites on 23 October 1981. Initially, the Commencement Bay site was divided into four areas: deepwater, nearshore, tideflats/industrial, and south Tacoma channel. The National Priorities List promulgated on 8 September 1983 designated the CB/NT area and the Commencement Bay South Tacoma Channel (CB/STC) as separate National Priorities List sites. The deepwater portion of the bay was eliminated from the list at that time because water quality studies indicated there was minimal contamination in the area.

On 13 April 1983, EPA announced that a cooperative agreement had been reached with Ecology to conduct a remedial investigation/feasibility study on the nature and extent of contamination in the CB/NT site. Under the agreement, Ecology was designated as the lead agency for the investigation. The *Commencement Bay Nearshore/Tideflats Remedial Investigation* (Tetra Tech 1985), completed in August 1985, characterized the nature and extent of contamination at the site. The *Commencement Bay Nearshore/Tideflats Feasibility Study* (Tetra Tech 1988a) was completed in December 1988, described feasible alternatives for sediment remedial action at the site. The feasibility study included an integrated action plan (PTI 1988) to coordinate ongoing source control efforts and sediment remedial alternatives, and a sediment quality goals document (PTI 1989) to develop sediment quality objectives. Public comment on the feasibility study was received from 24 February to 24 June 1989. General notice letters were sent by EPA to 133 PRPs on 24 April 1989 informing them of their potential liability for sediment contamination at the CB/NT site.

Contaminated sediments along the Ruston-Pt. Defiance Shoreline were further characterized during a site-specific remedial investigation for the ASARCO Tacoma smelter which was presented as public comment on the CB/NT feasibility study and proposed plan. These investigations confirmed a direct link between the ASARCO facility and sediment contamination. Due to these findings, sediment remedial action for the Ruston-Pt. Defiance Shoreline will not be addressed under the CB/NT sediments Record of Decision. Following public comment on a revised study and proposed plan, they will be addressed under a separate Record of Decision for a newly defined operable unit for the ASARCO sediments (see Section 5.1).

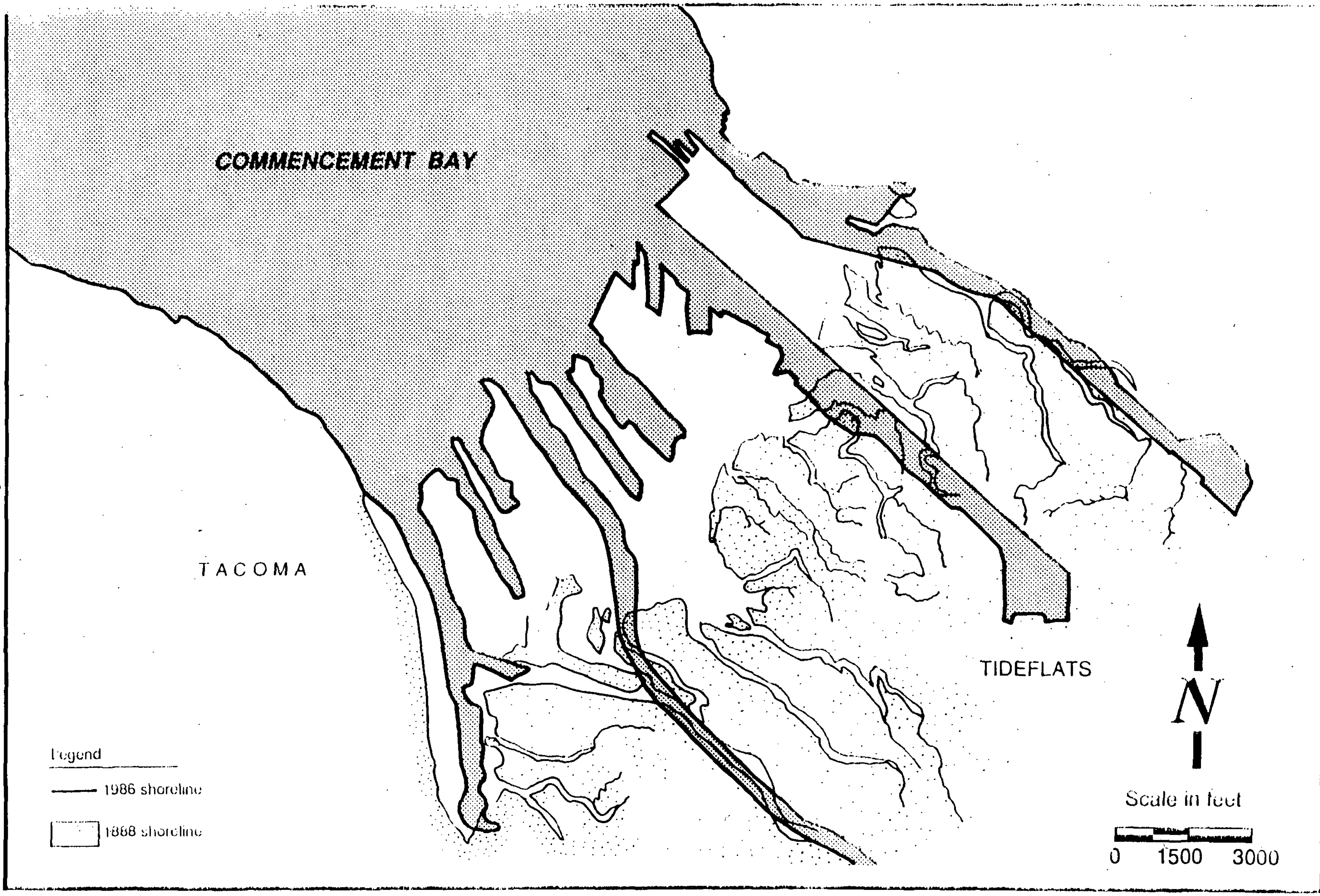


Figure 2. Commencement Bay tideflats and shoreline modifications as of 1986

In September 1988, the Simpson Tacoma Kraft Company completed source control activities and implemented sediment cleanup action. These actions, which were undertaken as part of a state consent decree signed in December 1987, consisted of the placement of a layer of clean sediment (i.e., a sediment cap) over contaminated sediments and restoration of intertidal and shallow subtidal habitats. Future EPA enforcement actions will expand response activities (e.g., sediment monitoring activities) at this problem area to be consistent with this Record of Decision.

In several areas, additional sediment sampling has been conducted either as part of planned dredging activities or in anticipation of pending CERCLA action.

3.2 MAJOR SOURCE CONTROL PROGRAMS

Several federal, state, and local programs address source control independently of CERCLA. These programs and the CERCLA pre-remedial program are described in this section.

There are four general categories of contaminant sources at the CB/NT site:

- Contaminated properties
- Wastewater discharges
- Air emissions
- Storm drains.

Contaminated properties exist throughout the CB/NT site. In many cases, groundwater and surface water discharges from these facilities represent significant sources of contamination to CB/NT sediments. In other cases, active facilities discharge wastewater to Commencement Bay directly via outfalls or storm drains. Wastewater discharged from some of these facilities contains problem chemicals that may contaminate receiving waters and sediments. Wastewater discharges are subject to regulation under one of three discharge programs: 1) NPDES, 2) Washington waste discharge permit, and 3) industrial pretreatment program. Historical and ongoing air emissions from facilities in the CB/NT site are sources of contamination via the deposition of airborne particulates. Stormwater runoff has been identified as a major source of heavy metals and other chemicals [e.g., high molecular weight polycyclic aromatic hydrocarbons (HPAHs) in Commencement Bay]. Only a small fraction of over 400 storm drains that discharge to the bay have been associated with sediment contamination. Control of storm drains and stormwater runoff is addressed under the federal Clean Water Act, the 1989 PSWQA plan (PSWQA 1988), and state water quality law. Under these programs, EPA and Ecology are required to develop a permit system and issue discharge permits for storm drains, and city and county governments are required to develop stormwater management programs.

Source control enforcement at the CB/NT site invokes many environmental programs and laws. Regulatory authorities and programs under the Resource Conservation and Recovery Act (RCRA), the Clean Water Act, the Clean Air Act, the Hazardous Waste Management Act, and the Washington Model Toxics Control Act are critical for enforcing source control actions (Table 1). In addition to these laws, the 1989 PSWQA plan (PSWQA 1988) establishes various programs and requirements related to source control (as well as sediment contamination). Programs and requirements under the PSWQA plan are designed primarily for enforcement and promulgation by Ecology. Enforcement of source control actions is accomplished primarily by the Commencement Bay UBAT, a task force organized under Ecology's Urban Bay Action Program, and other programs of Ecology, the city of Tacoma, and the TPCHD. These programs operate independently of CERCLA, both within the CB/NT site and offsite. However, CERCLA-directed source control will be closely coordinated with the above programs.

TABLE 1. REGULATORY AUTHORITIES FOR SOURCE CONTROL ACTIVITIES

Authority	Activities
Contaminated Facilities	
Federal and state hazardous substance cleanup programs under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Model Toxics Control Act	Under federal and state authorities, investigations, assessments, and remediation (including remedial investigation/feasibility study) are required by EPA and Ecology.
State Dangerous Waste Regulations	Procedures and criteria for identifying dangerous waste and extremely hazardous waste are enforced by Ecology.
Federal Resource Conservation and Recovery Act (RCRA)	Under federal authority, EPA and Ecology impose a permit system for facilities that treat, store, or dispose of hazardous materials.
Tacoma-Pierce County Health Department (TPCHD) Solid Waste Permit	Under authority of state solid waste laws and regulations, TPCHD issues permits for disposal sites for nonhazardous solid waste in the Tacoma area.
Wastewater Discharges	
National Pollutant Discharge Elimination System (NPDES)	Under the federal Clean Water Act, NPDES permits are required for all facilities with direct discharges to surface waters (NPDES permits will subsequently be required for some stormwater discharges).
Washington State Waste Discharge Permits	Washington state requires that all known available and reasonable methods of treatment be utilized for discharges of wastewater to surface water, municipal treatment plants, and groundwater (does not duplicate NPDES).
Industrial Pretreatment Program	Under the federal Clean Water Act, EPA set effluent standards for certain industry categories for discharges to municipal treatment plants. The city of Tacoma operates an industrial pretreatment program and issues permits to industries discharging to the treatment plant (program does not duplicate state waste discharge permits).

TABLE 1. (Continued)

Authority	Activities
Air Emissions	
Puget Sound Air Pollution Control Agency and Ecology	Prevention of Significant Deterioration permits are issued by either the Puget Sound Air Pollution Control Agency or Ecology, depending on source type. Ecology's air section issues permits for the aluminum, pulp and paper, and refinery industries. (Notice of Construction permits are issued by the Puget Sound Air Pollution Control Agency for facilities under construction.)
Storm Drains	
NPDES	The NPDES program has established a schedule for permitting storm drain systems based on the size of the service area. Permits will require development of plans for contaminant control.
TPCHD and city of Tacoma Marine Resource Protection Program and Storm Drain Program	These programs include source mapping, storm drain sampling, source control, interagency coordination, nonpoint source investigations, and permit reviews.
City of Tacoma storm drain construction and maintenance	Sewer inspections are conducted to assess physical integrity and proper function, and verify sewer hookups and sanitary sewer/stormwater separation.

3.2.1 Commencement Bay Urban Bay Action Team

Based on the results of the CB/NT remedial investigation, the Commencement Bay UBAT was formed by Ecology to expand previous and ongoing source control activities at the CB/NT site. Prior to 1987, the action team relied on state water quality and dangerous waste legislation (e.g., RCW 90.48 and 70.105) to enforce source control and remedial activities related to sources. Unilateral administrative orders as well as consent orders and decrees are the primary enforcement tools under these laws. After 1987, consent orders and decrees were issued pursuant to the enforcement authority set forth in the state Hazardous Waste Cleanup Act (RCW 70.105B). RCW 70.105B was replaced by the Model Toxics Control Act in March 1989, and all consent orders and decrees were subsequently issued from the enforcement provisions of the new law. The Model Toxics Control Act provides for direct intervention and cleanup of hazardous substances by the state and includes a provision for recovery of treble damages.

Discharge permits are also used to enforce source control activities at the CB/NT site. Discharge permits, provided for by NPDES under the Clean Water Act, are written and enforced by three programs at Ecology: the Commencement Bay UBAT, the southwest regional office water quality program, and the industrial section. NPDES permits are used to regulate direct surface water discharges. However, the effluent limits set in the permits have rarely included limits for toxic contaminants. The 1987 Clean Water Act and Element P-6 of the PSWQA plan (PSWQA 1988) both require adding toxic contaminant limits to NPDES permits. In addition to direct discharges, NPDES permits cover diffuse discharges such as sandblasting waste from shipyards and ship repair facilities.

Under the 1987 Clean Water Act, NPDES permits will be required for industrial storm drains and for cities with storm drains serving total populations of more than 250,000 by February 1991. NPDES permits will be issued to smaller cities serving populations of 100,000-250,000 by February 1993. In addition, the PSWQA plan requires that local governments begin developing stormwater management programs by 1 July 1989, and demonstrate significant progress by 1 July 1991. By the year 2000, the programs must be implemented.

The Commencement Bay UBAT coordinates its efforts with several other Ecology programs in enforcing source control activities. The solid and hazardous waste program and the hazardous waste investigations and cleanup program control dangerous or hazardous wastes that have been handled, stored, treated, or disposed of at the CB/NT site. The industrial section of Ecology administers NPDES permits; regulates solid and hazardous waste; and oversees cleanup of soil, air, and water for the aluminum, pulp and paper, and petroleum industries at the CB/NT site.

3.2.2 TPCHD Marine Resource Protection Program

The marine resource protection program was initiated by the Tacoma city council in April 1985 to improve water quality in Commencement Bay. Marine resource protection activities include mapping of pollution sources and new outfalls, routine storm drain sampling, source control, interagency coordination, investigation of nonpoint pollution, monitoring of Tacoma's industrial pretreatment program, and review of NPDES permits (Pierce et al. 1987). When contamination problems are discovered, marine resource protection personnel work with the source facility owner or operator, Ecology, city of Tacoma, and TPCHD to implement best management practices or other measures to minimize or eliminate contaminant discharges.

3.2.3 City of Tacoma

In 1984, under authority of Clean Water Act Section 307, the city of Tacoma established an industrial pretreatment program. Under the program, EPA sets effluent standards for certain categories of industries. Industries that discharge effluent to sanitary sewers must meet these standards. Stricter standards may be set by the municipal wastewater treatment plant receiving the effluent, to meet the permitted effluent limits of municipal NPDES permits. In addition to selfmonitoring requirements imposed by the permits, the city of Tacoma monitors all industries twice yearly. Source control activities that involve the discharge of effluent to Tacoma sanitary sewers must comply with the substantive requirements of the pretreatment program (e.g., discharge limitations and monitoring).

3.2.4 TPCHD/City of Tacoma Storm Drain Program

Pursuant to a memorandum of agreement between Ecology, the city of Tacoma, and the TPCHD, a program was initiated in August 1986 to identify and characterize sources contributing contaminants to several publicly-owned outfalls in Commencement Bay. The program currently focuses on a drainage system at the head of Sitcum Waterway, three drainage networks in City Waterway, and one drainage network in Wheeler-Osgood Waterway.

Tasks undertaken by the program include drainage basin characterization (inspection and documentation of industries and comprehensive drainage basin mapping), quarterly wet weather and dry weather monitoring of storm drain effluent, periodic monitoring of key catch basin sediments, and identification of sources (including roadway contaminant characterization). While most of the program has been completed, it is expected that storm drain monitoring and other activities (e.g., source identification) will continue over the long term.

3.2.5 CERCLA Pre-remedial Program

Various contaminated industrial sites listed in the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) are located within the CB/NT site. Contaminated sites listed in CERCLIS are either CERCLA sites or have the potential to become CERCLA sites. Twenty-six CB/NT CERCLIS sites do not require further action by the federal Superfund pre-remedial program because they are already addressed by non-CERCLA programs. Table 2 summarizes these 26 sites. Of the 26 CB/NT CERCLIS sites, 14 are currently considered to be potential sources of contaminants to the CB/NT problem areas addressed here. They are referred to as CB/NT source control sites in Table 2. Eighteen of the CERCLIS sites are being tracked and managed under non-CERCLA programs by Ecology's Commencement Bay UBAT. Enforcement authorities for these sites are described in Table 1. Eight CERCLIS sites are being managed under non-CERCLA programs by EPA, Ecology (non-UBAT), or TPCHD. Enforcement mechanisms for these eight sites include RCRA and state dangerous waste and county solid waste regulations.

3.2.6 Coordination of Source Control with Other Programs

Existing programs and requirements will provide the basic regulatory framework for the reduction or elimination of ongoing releases of toxic materials to the marine environment. For example, wastewater discharges from industrial and municipal facilities have been and will continue to be regulated under NPDES and state waste discharge permit programs. Releases of hazardous substances have been and will continue to be regulated under state and federal hazardous waste management laws. In most cases, discharge requirements are similar to requirements for comparable facilities in other parts of Puget Sound.

3.3 MAJOR SEDIMENT MANAGEMENT PROGRAMS

The major focus of the CB/NT Record of Decision is to correct sediment contamination problems via source control and sediment remediation. Sediment remediation may occur by natural recovery or sediment confinement. Removal of marginally contaminated sediment outside the designated problem areas may occur irrespective of remediation during routine navigational dredging. Sediment remedial activities in problem areas at the CB/NT site are driven by CERCLA. In addition, routine dredging in problem areas will be subject to the requirements of the multi-

TABLE 2. SITES AT THE COMMENCEMENT BAY NEARSHORE/TIDEFLATS SITE LISTED IN SUPERFUND INFORMATION SYSTEM

CB/NT Source Control Site	CERCLIS Identification Number	Site Name	Managing Agency
*[a]	WAD980738025	B&L Landfill	UBAT[b]
	WAD008958357	Cascade Pole Co., Inc. (McFarland)	Ecology[c]
*	WAD981763162	Cascade Timber Log Sorting Yard #1	UBAT
	WAD988466413	Cascade Timber Log Sorting Yard #2	UBAT
	WAD009281007	Coski Industrial Dump	UBAT
	WAD980514566	Dauphin Site	UBAT
	WAD980639645	Don Oline Landfill	UBAT
	WAD009248774	Georgia-Pacific	UBAT
*	WAD009253295	Louisiana-Pacific Corporation	UBAT
*	WAD980511653	Marine View Drive Site	UBAT
*	WAD089335160	Murray Pacific Log Sorting Yard #1	UBAT
*	WAD009253246	Pennwalt Chemical Corporation	UBAT
	WAD980511711	Petarcik Site	UBAT
*	WAD0676162586	Tacoma Boatbuilding Company	UBAT,Ecology
*	WAD009281403	TAM Engineering	UBAT
	WAD009242025	USG Company	UBAT
*	WAD980639140	USG Company, Hylebos Creek Dumpsite	UBAT
*	WAD981761794	Wasser-Winters Log Sorting Yard	UBAT
	WAD001829522	Allied Chemical Corporation - Tacoma Works	TPCHD
*	WAD083350231	American Plating Company	EPA
*	WAD070046511	Champion International (Simpson Tacoma Kraft)	Ecology
*	WAD001882984	Kaiser Aluminum and Chemical Corporation	Ecology
	WAD027543032	Lilyblad Petroleum, Inc./Sol-Pro	Ecology
*	WAD009242314	Occidental Chemical Corporation	EPA
	WAD009252628	Stauffer Chemical	TPCHD
	WAD009252719	U.S. Oil & Refining Company	Ecology

[a] * = Currently considered to be potential sources of contaminants to CB/NT problem areas.

[b] The Commencement Bay Urban Bay Action Team (UBAT) at Washington Department of Ecology's Southwest Regional Office.

[c] Washington Department of Ecology programs other than the Commencement Bay UBAT.

agency Puget Sound Dredged Disposal Analysis (PSDDA). If sediments in problem areas fail criteria for open-water unconfined disposal, sediment remediation will proceed as a CERCLA action.

Dredging and dredged material disposal in Commencement Bay are regulated by Clean Water Act Sections 404 and 401 (i.e., the state water quality certification process), Washington Department of Fisheries and Washington Department of Wildlife (hydraulics permits), Washington Department of Natural Resources (aquatic disposal site permits), city of Tacoma (shoreline substantial development permits), and PSDDA (procedures and guidelines for dredged material and disposal site testing). These authorities address the following aspects of sediment removal and disposal:

- **Clean Water Act Section 404 Permit**: Federal Clean Water Act Section 404 specifies requirements and guidelines for dredging and dredged material management, including designation of disposal sites. The U.S. Army Corps of Engineers (Corps) is responsible for processing and issuing permits under the Section 404 program. Federal guidance specifies procedures and criteria for achieving compliance with guidelines, evaluating and testing dredged material, developing and considering actions to minimize adverse effects, and issuing permits for the disposal of dredged material.
- **Puget Sound Dredged Disposal Analysis Procedures and Guidelines**: The Corps, EPA, Washington Department of Natural Resources, and Ecology have adopted a management plan for dredged material, which is suitable for unconfined open-water disposal, including disposal site locations, site conditions, dredged material evaluation procedures, disposal site management, disposal site monitoring, and dredged material data management (PSDDA 1988). These procedures and guidelines were developed under Clean Water Act Section 404.
- **State Water Quality Certification**: Pursuant to Clean Water Act Section 401, state water quality certification by Ecology is necessary for any project that may cause the violation of a state water quality standard.
- **Washington Department of Fisheries and Washington Department of Wildlife Hydraulics Permit**: Hydraulics permit regulations require the issuance of a hydraulics permit by the Washington Department of Fisheries and Washington Department of Wildlife for any project that may interfere with the natural flow of water.
- **Washington Department of Natural Resources Aquatic Disposal Site Permit**: WAC 332-30-166 establishes a procedure for site selection and a fee structure for site use. General requirements specified in WAC 332-30-166 are mirrored in PSDDA guidelines (see PSDDA Procedures and Guidelines, above).
- **City of Tacoma Substantial Development Permit**: The city of Tacoma has prepared a shoreline management plan pursuant to the state Shoreline Management Act. The Tacoma shoreline management plan establishes environmental designations for shoreline segments within city limits and establishes allowable uses and restrictions, requirements, and limitations for those uses. Shoreline management plan ordinances include provisions for application for a substantial development permit for projects within the shoreline area that are valued at more than $2,500.

Routine navigational dredging actions must meet all substantive and procedural requirements of these permit and certification programs. Sediment removal and disposal actions conducted under CERCLA must meet only the substantive requirements.

CERCLA requirements and procedures will be used to implement sediment remediation, including both monitoring for natural recovery and active remediation (e.g., capping, or removal and disposal). Sediment remediation will be developed in a phased approach according to priorities for action described in the *Commencement Bay Nearshore/Tideflats Integrated Action Plan* (PTI 1988) and clarified in this Record of Decision. Under CERCLA, sediment remedial action will be performed in compliance with the substantive requirements of existing environmental rules and regulations. Routine (i.e., non-CERCLA) sediment removal actions that contribute to the selected remedy must meet all permit requirements.

The sediment cleanup strategy proposed in the CB/NT feasibility study is consistent with and supportive of the major sediment quality management initiatives and programs of PSDDA, the PSWQA plan (PSWQA 1988), and the Puget Sound Estuary Program. Many of the actions proposed for the CB/NT site depend upon the successful implementation of these programs.

3.4 ENFORCEMENT ROLES OF EPA, ECOLOGY, AND THE PUYALLUP TRIBE

This Record of Decision represents a significant transition in agency management and oversight of the CB/NT project. During the remedial investigation/feasibility study phase of the project, Ecology had the lead management role through a cooperative agreement with EPA. Ecology was responsible for developing the remedial investigation/feasibility study and for implementing source control measures for many of the major sources that were identified during the remedial investigation/feasibility study.

In March 1988, a management strategy was developed by EPA and Ecology that was intended to define responsibilities following the Record of Decision. It was agreed that Ecology would maintain the lead for source control because of the multi-programmatic enforcement capability of the Commencement Bay UBAT, and EPA would assume the lead for sediment remedial action because of EPA's experience in managing multi-party cleanup actions.

The dual-lead concept of CB/NT project management was formalized on 30 June 1989 in a cooperative agreement between EPA and Ecology. The agreement provides for an additional level of federal funding to Ecology that will double the size of the Commencement Bay UBAT during the active cleanup phase of the CB/NT project. Under the terms and conditions of the agreement, Ecology assumes responsibility for CB/NT source control actions which are to be implemented under various enforcement authorities in a manner that closely parallels the Superfund process. For example, community relations activities are to be included in accordance with the requirements and guidance of CERCLA and the NCP.

The primary purpose of the cooperative agreement is to significantly enhance the Commencement Bay UBAT's ability to meet the project goals for source control in a timely manner. The agreement is also intended to ensure coordination with other environmental programs that continue to play a key role in successful project implementation (see Section 3). Under the terms and conditions of the agreement, source control will be implemented by Ecology on a facility- or property-specific basis according to the schedule outlined in Section 12.6. Reporting requirements include periodic progress reports and submittal of a final Superfund completion report for each of the eight CB/NT problem areas described in this Record of Decision. Progress reports will be used to update and revise CB/NT implementation schedules on an annual basis. Completion reports will summarize the status of enforcement activities upon completion of source control (see Section 10.3) and will require approval by the EPA Regional Administrator. Adjustments to the agreement and/or utilization of other resources by either agency may be necessary in order to meet the CB/NT objectives for source control.

In contrast, sediment remediation will be implemented in each problem area under EPA oversight. EPA recently conducted a search to identify PRPs for each of the eight CB/NT problem areas of concern. These PRPs were notified of their potential Superfund liability for sediment investigation and cleanup activities in a CERCLA general notice letter issued by EPA in April 1989. The letter requested the PRPs to clarify the status of their involvement at the site and respond to questions regarding the use and disposal of hazardous substances at the site. As appropriate, EPA will pursue CERCLA settlements with PRPs for sediment remediation in each of the problem areas. EPA's legal enforcement and cost recovery efforts for Operable Units 01 and 02 will focus on those PRPs identified by EPA for each of the eight CB/NT problem areas described in this Record of Decision. Owners and operators of businesses and properties within the CB/NT site, but not associated with sediment contamination problems in the eight CB/NT problem areas, will not be issued special notice letters or designated as PRPs in conjunction with this project. EPA may conduct additional investigations or name additional PRPs if new information is received that demonstrates that a party may be liable for response actions described in this Record of Decision.

In addition, some property owners and operators may be notified by Ecology of potential liability for response actions in the tideflats area. In some cases, notification by Ecology may be related to CB/NT source control efforts. Source control actions by Ecology will be very closely coordinated with EPA efforts to clean up sediments in waterways and shoreline areas. In other cases, Ecology may contact property owners and operators in the tideflats area for reasons unrelated to the CB/NT Superfund project.

The role of the Puyallup Tribe of Indians was limited during the remedial investigation/ feasibility study phase of the project. As a member of the CB/NT technical oversight committee (see Appendix B, Responsiveness Summary) the tribe's primary role was to review project documents. In 1986, Congress expanded the tribe's CERCLA role under SARA, giving it substantially the same opportunities for project oversight and implementation afforded the state. In response, EPA entered into a Superfund memorandum of agreement (27 April 1989) and a cooperative agreement (28 April 1989) with the tribe that provided for participation as a supporting agency, especially with regard to evaluation and restoration of threatened or impacted natural resources and important habitats within the project boundaries.

3.5 SCHEDULING AND COORDINATION OF SOURCE CONTROL AND SEDIMENT REMEDIAL ACTION

Correction of sediment contamination problems at the CB/NT site will be implemented over a period of several years. In the short term, regulatory efforts will focus on measures to reduce or eliminate the ongoing release of contaminants. These measures, in conjunction with natural processes such as biodegradation and sedimentation, will reduce exposure to contaminated sediments. After source control measures are implemented in a particular problem area, sediment remedial action will be initiated (see Section 10.3).

As indicated in previous sections, correction of sediment contamination problems, including source control, will be implemented by several agencies using a wide variety of existing regulatory authorities. Relationships among the CB/NT project and other federal, state, tribal, and local programs are important jurisdictional considerations during the cleanup phase of the project. For example, during this period it is anticipated that routine dredging projects (i.e., projects not related to Superfund) will continue to occur. The relationships between the CB/NT project and various non-Superfund projects are described in more detail in the feasibility study.

4. HIGHLIGHTS OF COMMUNITY PARTICIPATION

A revised community relations plan was recently completed by EPA, in cooperation with Ecology and TPCHD. The plan summarizes past site activities for all operable units of both the CB/NT and CB/STC Superfund sites since 1981 when both sites were incorporated as the Commencement Bay site. The plan also describes ongoing community concerns and outlines agency plans for present and future community involvement.

The agencies interviewed community members in 1983 to determine community concerns, and to plan community relations activities and opportunities for public involvement. In 1987, the agencies interviewed 30 additional persons to reassess community interest and concerns, and to revise the community relations plan.

The most interested groups, on a continuing basis, have been local officials, the Puyallup Tribe of Indians, local businesses, local environmental and citizens groups, and other federal, state, and local agencies. The most consistent community involvement has come from a Citizens Advisory Committee and a Technical Oversight Committee.

Media and community interest in the CB/NT site increased as the feasibility study neared completion, focusing on the costs, benefits, and other considerations of cleanup. At the request of several parties, the agencies planned for a 120-day public comment period on the CB/NT feasibility study and proposed plan. The agencies held two formal public meetings while agency site managers met with over 20 interest groups. The public meeting transcripts are in the Administrative Record. The Citizens Advisory Committee attracted approximately 50 people to a citizens workshop designed to inform community members about these projects. During the public comment period, EPA and Ecology established an information booth at the Tacoma Fire Department Fireboat Station. Agency representatives were available at the booth one day per week to answer questions from members of the community. During this period, the print, radio, and television media increased their coverage of the issues.

The CB/NT remedial investigation (Tetra Tech 1985) was published in August 1985. The CB/NT feasibility study (Tetra Tech 1988a) including the integrated action plan (PTI 1988), the sediment quality goals report (PTI 1989), and the proposed plan were released to the public in February 1989. Ecology and EPA have met the statutory public participation requirements of SARA Section 117 by:

- Establishing 5 main and 12 satellite information repositories and making the administrative record of site information available at the Tacoma Public Library main branch (near the site)
- Publishing a notice and brief analysis of the proposed plan in the Tacoma News Tribune on 24 February 1989
- Providing a 120-day public comment period (from 24 February 1989 until 24 June 1989) on the proposed plan and cleanup alternatives
- Holding two public meetings during the public comment period at the Tacoma Yacht Club, transcripts of which were placed in the information repositories and administrative record
- Considering and responding to comments when selecting the remedy. (A summary of significant comments and responses is included in Appendix B. Significant changes from the proposed plan and the reasons for such changes are described in Section 12.)

EPA will publish a notice of the final remedial action plan in the Tacoma News Tribune and will mail a fact sheet describing the plan to the mailing list of interested persons within 30 days of signing this document.

The agencies will continue to encourage public involvement and provide information about site activities. For example, the agencies will continue to maintain information repositories to ensure that relevant documents and information are conveniently available for public review. The agencies also will maintain the mailing list and send periodic fact sheets describing ongoing activities. The Citizens Advisory Committee is continuing to meet. EPA and Ecology will provide the committee with information and attend meetings as requested. Agency representatives also will meet with other groups of interested citizens as requested.

In recognition of the scope and complexity of the CB/NT site, EPA is establishing a Technical Discussion Group for the remedial design and remedial action phase, and to integrate and expand the information exchange of the Technical Oversight Committee and Citizens Advisory Committee. Membership of the Technical Discussion Group is intended to include the CB/NT site management team, representatives of regulatory agencies and programs, PRPs, local government, interested citizens, and organized citizens groups. The Technical Discussion Group will provide a forum for the general review of technical and planning issues during the cleanup phase of the project. Discussion topics may include a wide range of issues related to project status, planning, sediment management and habitat concerns, health issues, and local development. It is hoped that the Technical Discussion Group will provide EPA with valuable insight into issues of concern, and thereby contribute to project direction and findings. However, group input will not form EPA policy or determine EPA's course of action, nor will it preclude the 30-day public comment period required upon completion of negotiated agreements between EPA and PRPs for sediment cleanup in each of the problem areas. Meetings will be scientific and technical in nature; legal matters will not be discussed.

In addition, most source control activities will include public involvement as part of the project implementation. For example, major source control enforcement actions conducted by Ecology under the state's Model Toxics Control Act, and other actions requiring permits, will include formal public comment periods. The CB/NT cooperative agreement with EPA also requires Ecology to conduct community relations activities in accordance with CERCLA and the NCP.

5. SCOPE OF RESPONSE ACTION WITHIN OVERALL SITE STRATEGY

This Record of Decision is final and comprehensive for two of the six operable units at the CB/NT site, Operable Unit 05 (Source Control), and Operable Unit 01 (Sediment Remediation). All six operable units, including the Tacoma tar pits and three ASARCO-related projects, are described in the following subsection. The purpose of CB/NT response actions addressed in this Record of Decision is to mitigate or correct impacts directly associated with contaminated marine sediments in the CB/NT site. The Record of Decision is therefore focused on contaminated sediments, contaminant sources, impacts to marine organisms, and specific human exposure pathways (i.e., consumption of seafood and dermal contact with sediment). However, the CB/NT Superfund project is not intended to address other types of environmental or public health problems within the site boundaries that should be adequately covered by other federal, state, tribal, or local programs. Problems not within the scope of the CB/NT project include contaminated properties and sources within the site boundaries that do not appear to impact marine sediments.

The scope of the CB/NT response action is also distinct from other federal Superfund projects that were originally combined in the Commencement Bay investigation in October 1981. The Commencement Bay site was divided into four areas: deepwater, nearshore, tideflats and south Tacoma channel. Subsequently the deepwater area was eliminated as a priority site because water quality studies indicated less severe contamination in that area than was originally suspected. The remaining areas have been separated into two discrete Superfund sites since December 1982, the CB/NT site and the CB/STC site.

The CB/STC site, located approximately 3 miles southwest of City Waterway, includes three projects: Well 12A, the Tacoma municipal landfill, and the Tacoma swamp. Although there is no apparent groundwater connection between the two Commencement Bay Superfund sites, there is a surface water link. A major storm drain network directs surface water runoff from the CB/STC site to the head of City Waterway. However, none of the CB/STC projects are currently considered a significant source of contaminant loading in the CB/NT site.

5.1 SCOPE AND ROLE OF COMMENCEMENT BAY NEARSHORE/TIDEFLATS OPERABLE UNITS

Superfund response actions at the CB/NT site are currently coordinated under six separate operable units. The six operable units constitute a comprehensive remedial response to actual or threatened releases of hazardous substances that are associated with the Tacoma tar pits, the ASARCO Tacoma smelter, and the CB/NT marine environment. The six CB/NT operable units are listed below:

- Operable Unit 01 - CB/NT Sediments
- Operable Unit 02 - ASARCO Tacoma Smelter
- Operable Unit 03 - Tacoma Tar Pits
- Operable Unit 04 - ASARCO Off-Property (Residential)
- Operable Unit 05 - CB/NT Sources
- Operable Unit 06 - ASARCO Sediments.

The CB/NT operable units have been designated by EPA over the course of several years in response to changing project needs as the agencies develop a better understanding of the overall CB/NT site. The numbering sequence used to identify each operable unit is simply chronological.

For example, Operable Unit 06 was established most recently. The role of the CB/NT operable units within the overall site strategy has been redefined and adjusted by EPA management during the public comment period for the CB/NT feasibility study, as described below. For each operable unit either EPA or Ecology is described as the lead oversight agency. In each case, when one agency is the lead agency, the other acts as a supporting agency.

5.1.1 Operable Unit 01 - Commencement Bay Nearshore/Tideflats Sediments

Until recently Operable Unit 01 was described as CB/NT *Areawide*, which referred to the entire site, exclusive of the Tacoma tar pits and ASARCO-related upland projects. Operable Unit 01 included response actions designed to combine both source control and sediment remediation to address problems related to contaminated marine sediments throughout the site. Thus the CB/NT remedial investigation/feasibility study, for which Ecology had the lead management responsibility, characterized and evaluated sources as well as sediment problems within the site. In March 1988, EPA and Ecology developed a management strategy designed to take maximum advantage of agency resources during continued response actions at the site. That strategy identified Ecology as the lead agency for continued source control efforts and EPA as the lead agency for subsequent sediment remediation. As a result, Operable Unit 01 was redefined to include response actions related to sediment remediation, and Operable Unit 05 was created to address source control activities.

This Record of Decision confirms the CB/NT site boundaries described in the CB/NT feasibility study and serves as the blueprint for further response actions within the site. As stated in the CB/NT remedial investigation/feasibility study, sediment contamination problems in low priority areas of the site do not appear to warrant further action under the federal Superfund program. Therefore, while the CB/NT site boundaries remain unchanged, continued response actions governed by this Record of Decision are limited to source control and sediment remediation within the priority areas defined in the CB/NT feasibility study.

Response actions governed by this Record of Decision are further limited to eight of the nine CB/NT problem areas that were defined in the remedial investigation/feasibility study. As described below under Operable Unit 06, a final decision regarding the Ruston-Pt. Defiance Shoreline problem area is deferred entirely to the subsequent ASARCO Sediments (Operable Unit 06) Record of Decision.

Oversight management of Operable Units 01 and 05 will be coordinated by EPA, Ecology and the Puyallup Tribe. Remedial design and remedial action tasks will be tracked separately for source control and sediment remediation in each of the eight CB/NT problem areas addressed in this Record of Decision. The management strategy for the site identifies Ecology as the lead agency for source control, EPA as the lead agency for sediment remediation, and the Puyallup Tribe as a supporting agency for continuing response actions with a particular focus on natural resource issues. Cooperative agreements defining these relationships were reached between EPA and the Puyallup Tribe on April 29, 1989 and between EPA and Ecology on June 30, 1989. These three agencies will share responsibility for coordination with other ongoing and related programs, as described in Section 3.4, Enforcement Coordination.

5.1.2 Operable Unit 02 - ASARCO Tacoma Smelter

Arsenic and other hazardous substances contaminate the ASARCO Tacoma smelter site, private and public properties in the surrounding community, and the adjacent shoreline. Stack emissions, slag, and fugitive dust from the ASARCO facility are the confirmed sources of contaminants. The smelter operated for almost 100 years before closing in 1985 for economic reasons. ASARCO, Inc., the current owner and former operator of the smelter, has agreed to the terms of an EPA administrative consent order (September 1986) to conduct a remedial investigation/feasibility study for the facility.

The remedial investigation for the ASARCO facility was completed in July 1989, and the public review draft of the feasibility study is to be completed in October 1989. Both reports include significant new information regarding marine sediment problems near the ASARCO facility. A Record of Decision for Operable Unit 02, including plans for cleanup and stabilization of the site, is expected to be completed this year. EPA is the lead oversight agency for the ASARCO facility.

5.1.3 Operable Unit 03 - Tacoma Tar Pits

The Tacoma tar pits, an historical coal gasification site located near the mouth of the Puyallup River, was operational from the 1920s through 1956. The site is currently used as a scrap metal yard. Contaminants including tar wastes (PAHs), PCBs, and heavy metals have been found in site soils, surface water, and groundwater. A Record of Decision for the site, completed in December 1987, called for a combination of excavation and treatment of the most highly contaminated soils, capping of the remaining areas of the site and continued monitoring of groundwater near the site. The site is now in the remedial design phase with remedial action expected to begin in 1991. EPA is the lead oversight agency for the Tacoma tar pits.

5.1.4 Operable Unit 04 - ASARCO Off-Property

Federal, state, and local environmental and public health agencies have conducted extensive studies to determine the risks associated with arsenic exposure in areas surrounding the ASARCO Tacoma smelter. An exposure pathways study identified young children as the population most at risk and contaminated soils as the medium of highest concern. In March 1989, ASARCO agreed to an EPA consent order requiring the company to perform an expedited response action at 11 publicly accessible off-property areas. The expedited response action will provide cleanup and capping of the areas and will be followed by a more comprehensive remedial investigation/ feasibility study of off-property problems in the surrounding area. EPA has the lead oversight role for the ASARCO off-property response actions.

5.1.5 Operable Unit 05 - Commencement Bay Nearshore/Tideflats Sources

The identification and control of sources of contamination in the marine environment at the CB/NT site is recognized as the most challenging and critical component of the overall response strategy. Ecology's Commencement Bay UBAT has been established in direct response to this challenge. Although the action team operates within a jurisdictional area that exceeds the CB/NT site boundaries, its enforcement activities have focused on major sources within CB/NT priority problem areas since publication of the CB/NT remedial investigation in August 1985. The action team's role in the CB/NT Superfund project is clearly defined in the cooperative agreement for source control awarded to Ecology by EPA on June 30, 1989. That role is specifically limited to activities that pose an actual or potential threat to marine sediments in the eight problem areas governed by this Record of Decision. Ecology is the lead oversight agency for Operable Unit 05 (Sources).

5.1.6 Operable Unit 06 - ASARCO Sediments

The Ruston-Pt. Defiance Shoreline problem area described in the feasibility study has been designated Operable Unit 06. This change reflects new information received during the public comment period. At that time, the agencies received as public comment a remedial investigation for the ASARCO Tacoma smelter and off-shore sediments. This report included detailed new information about characteristics, areal extent, and volume of contaminated sediments along the Ruston-Pt. Defiance Shoreline. The agencies have reviewed this information and believe that further detailed analysis of remedial alternatives for this problem area is needed. The new information submitted during the comment period indicates that sediment toxicity problems associated with coarse-grained slag particles in this problem area may be less severe than predicted in the CB/NT feasibility study. Therefore, significant changes regarding the estimated volume of contaminated sediments, the preferred sediment remedial alternative, and the cost of this remedy can be anticipated.

The portion of the CB/NT feasibility study for the Ruston-Pt. Defiance Shoreline problem area is currently being revised. Once the agencies have re-evaluated the feasible remedial alternatives for this problem area, EPA and Ecology will issue a new proposed plan for a 30-day public comment period. After consideration of public comments, the agencies will select a remedy for the operable unit and issue another Record of Decision specific to the CB/NT Ruston-Pt. Defiance Shoreline problem area.

5.2 COORDINATION OF OPERABLE UNITS 05 (SOURCES) AND 01 (SEDIMENTS)

Operable Unit 05 (Source Control) and Operable Unit 01 (Sediment Remediation) are addressed in a single Record of Decision because these two response activities must be closely coordinated to ensure successful implementation of the overall site remedy. Sediment remedial action cannot proceed until major sources of contamination have been controlled, because ongoing sources could recontaminate clean sediments exposed by dredging or laid down as capping material. Comprehensive source control as defined by this Record of Decision is essential to ensure that the overall remediation is permanent. Consequently, source identification and control programs are ongoing and will continue beyond the completion of remedial actions.

6. SITE CHARACTERISTICS

Hazardous substances and waste materials have been released into the Commencement Bay environment since the beginning of industrial activity in the area. As a result of various uses and releases of waste materials, the chemical quality of the waters and sediments in many areas of Commencement Bay has been altered. Contaminants found in the area include arsenic, lead, zinc, cadmium, copper, mercury, and various organic compounds such as PCBs and PAHs.

Contaminants in the CB/NT area originate from both point and nonpoint sources. Industrial surveys conducted by the TPCHD and the Port of Tacoma indicate that there are more than 281 active industrial facilities in the CB/NT area. Approximately 34 of these are NPDES-permitted dischargers, including two sewage treatment plants. Nonpoint sources include two creeks; the Puyallup River; numerous storm drains, seeps, and open channels; groundwater seepage; atmospheric deposition; and spills. The TPCHD has identified approximately 480 point and nonpoint sources that empty into the CB/NT area (Rogers et al. 1983). The network of channels, streams, and pipelines discharging to the CB/NT site is illustrated in Figure 3.

The primary objective of the remedial investigation was to define the nature and extent of sediment contamination. That investigation involved the compilation and evaluation of existing data and an extensive field sampling effort to collect additional data. The CB/NT database developed during the remedial investigation consisted of 23 data files, each storing a different kind of data. Data of different kinds were linked together by common identifiers (e.g., survey, station, drainage). At the conclusion of the remedial investigation, the database contained over 25,000 records, each consisting of 15-150 separate variables. There were descriptions of over 50 surveys, 500 sampling stations, and 2,000 samples of water, solids, and biota. Over 400 components of the Commencement Bay drainage system had been identified. Included were data on sediment and water column chemistry, bioassays, benthic invertebrates, fish pathology, and bioaccumulation. All data were subjected to rigorous quality assurance procedures before entering the database. The distribution of sediment contaminants is described in detail in the remedial investigation report (Tetra Tech 1985).

There is considerable variation in the types and concentrations of chemical contaminants in CB/NT sediments. Investigations of the nearshore waters of Commencement Bay have demonstrated the existence of sediment contamination by toxic pollutants, accumulation of some of these substances by biota, and possible pollution-associated abnormalities in indigenous biota (Crecelius et al. 1975; Riley et al. 1980, 1981; Malins et al. 1980, 1982; Gahler et al. 1982; Tetra Tech 1985, 1988b; Parametrix 1987). The highest concentrations of certain metals (i.e., arsenic, copper, lead, and mercury) have been found in sediments in the waterways, along the southwest shore, and near the ASARCO smelter. Sediment contamination by persistent organic compounds (e.g., PCBs) was detected in the heavily industrialized waterways (e.g., Hylebos Waterway) and along the Ruston-Pt. Defiance Shoreline.

During the CB/NT remedial investigation, four inorganic and six organic contaminants were detected at concentrations 1,000 times as great as reference conditions (i.e., conditions in sediments from nonindustrialized areas of Puget Sound). Those concentrations were detected in samples from stations located off the Ruston-Pt. Defiance Shoreline, Hylebos Waterway, and St. Paul Waterway. Twenty-eight chemicals or chemical groups had concentrations 100-1,000 times as great as reference conditions. Contaminants of concern include metals (e.g., arsenic, lead, mercury, zinc), PCBs, and PAHs.

Sediments in many parts of the CB/NT area contain concentrations of one or more toxic contaminants that exceed levels commonly found in Puget Sound reference areas. During the remedial investigation, a multistep decision-making process was used to 1) define problem sediments and identify areas containing problem sediments, 2) identify problem chemicals, and 3)

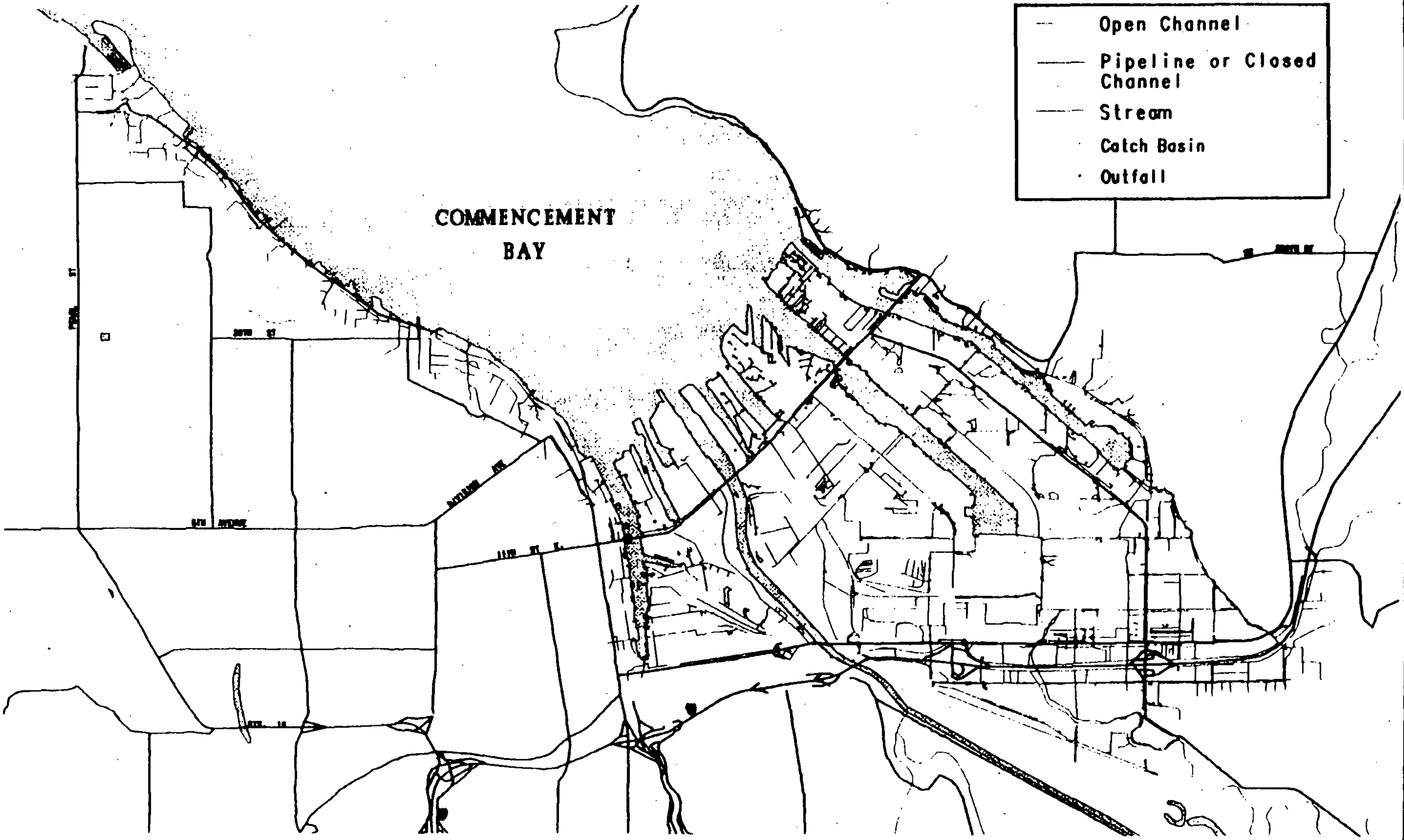


Figure 3. Commencement Bay drainage network

identify problem areas for remedial action evaluation. This process resulted in the identification of 11 high priority problem areas, which were subsequently consolidated into 9 areas (see Figure 1). The Ruston-Pt. Defiance Shoreline has been recently established as Operable Unit 06 (ASARCO Sediments) reducing the number of problem areas addressed in this Record of Decision to eight.

In the following section, the characteristics of sediments and sources in each of these problem areas are described. Figures present the estimated extent of contamination for each problem area. As indicated in the figures, the depth of contamination varies. For the purposes of volume calculations, average depths ranging from 0.5 to 2.5 yards have been utilized. Source control activities are planned, underway, or completed for many of the sources in these problem areas. Details of the status of these activities are presented in Appendix C and the integrated action plan (PTI 1988).

6.1 HEAD OF HYLEBOS WATERWAY

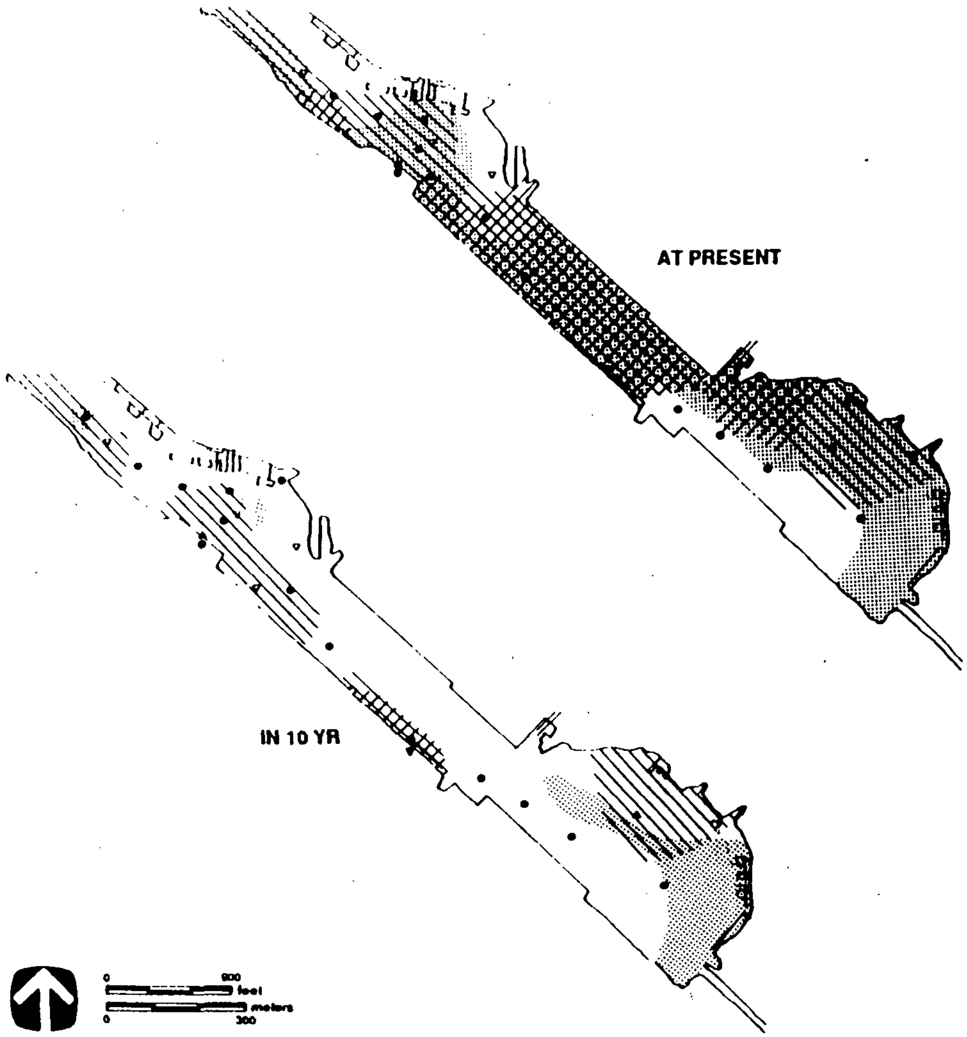
Contamination in sediments at the Head of Hylebos Waterway is attributed to a broad range of sources including chemical factories, log sorting yards, landfills in the Hylebos Creek drainage basin, and storm drains.

Sediment Characteristics—Three chemicals were selected as indicators of the most severe sediment contamination: arsenic, HPAHs, and PCBs. Approximately 381,000 square yards of sediments at the Head of Hylebos Waterway exhibited chemical concentrations that exceed cleanup objectives. Implementation of source control measures was predicted to reduce this area to approximately 217,000 square yards after 10 years (Figure 4).

Source Characteristics—Locations of existing industries and businesses in the vicinity of Hylebos Waterway are presented in Appendix C. Kaiser Aluminum and Chemical Corporation was identified as the major source of HPAHs in sediments at the Head of Hylebos Waterway (Tetra Tech 1985, 1988a). HPAHs were associated with the historical onsite disposal of wet scrubber sludge waste generated during air emission controls. Pennwalt Corporation was identified as a major source of arsenic (associated with arsenic pesticides), chlorinated hydrocarbons, and low molecular weight polycyclic aromatic hydrocarbons (LPAHs) in sediments at the Head of Hylebos Waterway (Tetra Tech 1985, 1988a). Groundwater seeps and the main outfall are the major points of arsenic release from the facility. Loading calculations indicate that groundwater seeps and the main outfall are the major sources of chlorinated hydrocarbons. General Metals of Tacoma, Inc. was identified as a potential source of PCBs in the Head of Hylebos Waterway. An ongoing source of PCBs was not identified during the CB/NT remedial investigation (Tetra Tech 1985); however, a subsequent reconnaissance survey found high levels of PCBs in catch basin sediments at General Metals (Stinson et al. 1987).

Various sources have been associated with metal contamination. Log sorting yards that have been identified as sources of arsenic, copper, lead, and zinc in the Head of Hylebos Waterway (Tetra Tech 1985, 1988a) include the 3009 Taylor Way log sorting yard, Cascade Timber Yard #2, Wasser Winters log sorting yard, and Louisiana-Pacific log sorting yard. ASARCO smelter slag used as ballast for many of the log sorting yards is the original source of the metals. Surface water runoff has been identified as the mechanism by which metals were transported to the adjacent sediments (Norton and Johnson 1985).

B&L Landfill and USG Landfill (formerly U.S. Gypsum) were associated with arsenic, copper, and lead in sediments at the Head of Hylebos Waterway. Leachate and runoff from the sites transport metals to Hylebos Creek, which discharges to the Head of Hylebos Waterway. The fill at B&L Landfill consists primarily of soil and wood waste scraped from the log sorting yards. ASARCO smelter slag, which was used as ballast at the log sorting yards, is probably the original source of the metals. Arsenic from USG Landfill was attributed to the disposal of baghouse dust.



Head of Hylebos Waterway Indicator Chemicals

AT PRESENT	
DEPTH (yd)	1
AREA (yd^2)	381,000
VOLUME (yd^3)	381,000
IN 10 YR	
DEPTH (yd)	1
AREA (yd^2)	217,000
VOLUME (yd^3)	217,000

▲ FEASIBILITY STUDY SEDIMENT PROFILE SURVEYS (1986)

● SEDIMENT SURVEYS CONDUCTED IN 1984

▽ SEDIMENT SURVEYS CONDUCTED BEFORE 1984 (1979-1981)

PCB (AET = 150 µg/kg)

HPAH (AET = 17,000 µg/kg)

ARSENIC (AET = 57 mg/kg)

Tetra Tech (1988a)

Figure 4. Sediments at the Head of Hylebos Waterway not meeting sediment quality objectives for indicator chemicals at present and 10 years after implementing feasible source control

Tacoma Boatbuilding Company may be associated with problem metals in sediments at the Head of Hylebos Waterway. Metals from the site probably originated from sandblasting and painting.

Several storm drains may discharge contaminants to the Head of Hylebos Waterway. The most important of these are East Channel, Morningside, and Kaiser ditches. In general, problem chemicals associated with these drains are poorly characterized, and the relationships among activities in the basin and problem chemicals observed in the sediments near the points of discharge are not well understood.

6.2 MOUTH OF HYLEBOS WATERWAY

Sediment Characteristics—PCBs and hexachlorobenzene were selected as chemical indicators at the Mouth of Hylebos Waterway. Approximately 393,000 square yards of sediments exhibited chemical concentrations that exceed cleanup objectives in this problem area. Implementation of source control measures is predicted to reduce this area to less than 115,000 square yards after 10 years (Figure 5).

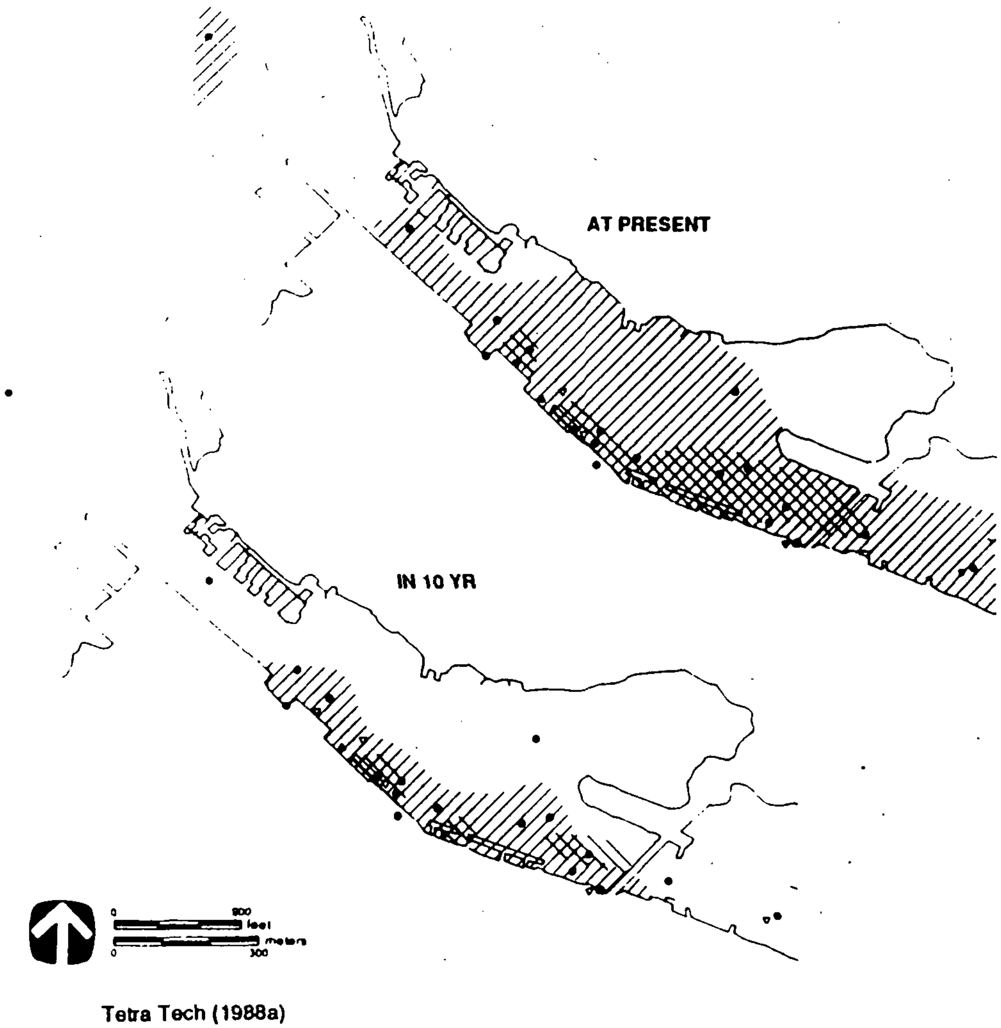
Source Characteristics—Occidental Chemical Corporation is the major source associated with chlorinated organic compounds, the major class of problem chemicals found in sediments at the Mouth of Hylebos Waterway. The locations of existing industries and business are provided in Appendix C. Groundwater seeps and the main plant outfall transport chlorinated organic compounds to the adjacent sediments. Loading calculations indicate that groundwater seeps are the most important sources (Tetra Tech 1985). Chlorinated organic compounds in groundwater are attributed to the historical disposal of wastes from solvent production in unlined lagoons on the site (Tetra Tech 1985, 1988a). Chlorinated organic compounds in the main outfall are associated with effluent from the chlorine stripper. The main outfall is classified as a major industrial discharge under the NPDES program.

6.3 SITCUM WATERWAY

Sediment Characteristics—Copper and arsenic were selected as chemical indicators of the most severe environmental contamination associated with biological effects. Approximately 167,000 square yards of sediments in this problem area exhibited chemical concentrations exceeding cleanup objectives. Implementation of source control measures is predicted to reduce this area to less than 66,000 square yards after 10 years (Figure 6).

Source Characteristics—Contamination in the sediments of Sitcum Waterway is attributed to ore loading facilities and storm drains. The locations of existing industries, businesses, and discharges are provided in Appendix C. The Port of Tacoma Terminal 7 ore loading facility (which includes Storm Drains SI-168 and SI-169) is associated particularly with metal contamination in the sediments of Sitcum Waterway. Ore spilled during unloading and transfer operations and runoff from the site are the sources of the metals. Spilled ore is no longer washed into the waterway but instead is collected in a sweeper truck and sold to smelters.

Numerous storm drains discharge to Sitcum Waterway. Storm Drain SI-172, the largest (serving approximately 170 acres), has been identified as the source of most of the metals contributed by storm drains (Tetra Tech 1985). Storm Drain SI-172 is one of five major storm drains discharging to Commencement Bay waterways that is included in the pollution control effort underway by the city of Tacoma under a memorandum of agreement between the city, TPCHD, and Ecology. Other storm drains potentially discharge contaminants to Sitcum Waterway via runoff. The most important of these is Storm Drain SI-176, which may contribute remaining waste material from the Milwaukee railroad yard located in its drainage basin. In general, problem chemicals

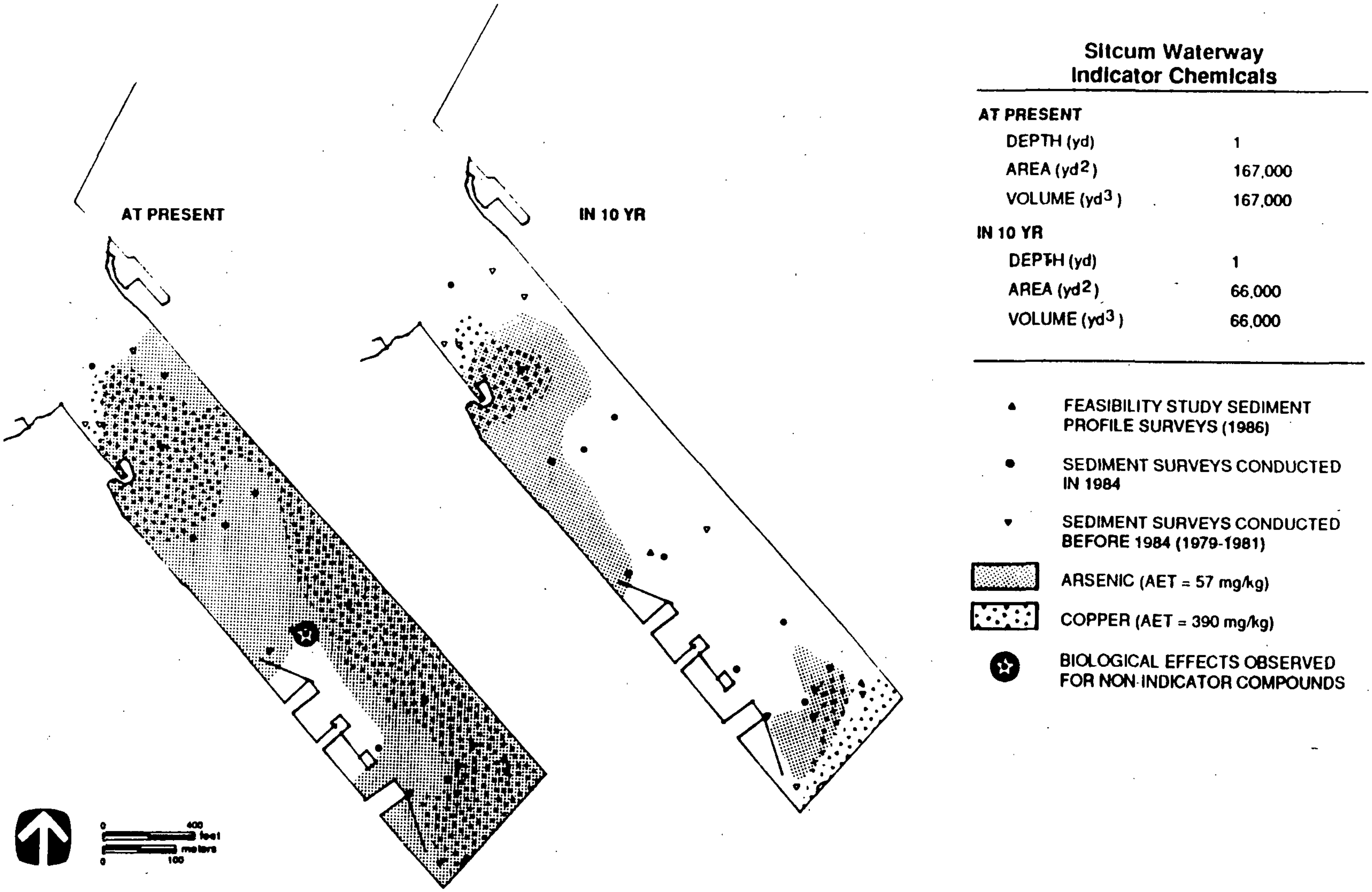


Mouth of Hylebos Waterway
Indicator Chemicals

AT PRESENT	
DEPTH (yd)	2
AREA (yd^2)	393,000
VOLUME (yd^3)	786,000
IN 10 YR	
DEPTH (yd)	2
AREA (yd^2)	115,000
VOLUME (yd^3)	230,000

- FEASIBILITY STUDY SEDIMENT PROFILE SURVEYS (1986)
- SEDIMENT SURVEYS CONDUCTED IN 1984
- SEDIMENT SURVEYS CONDUCTED BEFORE 1984 (1979-1981)
- PCBs (AET = 150 µg/kg)
- HEXACHLOROBENZENE (AET = 22 µg/kg)

Figure 5. Sediments at the Mouth of Hylebos Waterway not meeting sediment quality objectives for indicator chemicals at present and 10 years after implementing feasible source control



Tetra Tech (1988a)

Figure 6. Sediments in Sitcum Waterway not meeting sediment quality objectives for indicator chemicals at present and 10 years after implementing feasible source control

associated with these drains are poorly characterized, and the relationships between activities in the basin and problem chemicals observed in the sediments in Sitcum Waterway are not well understood.

6.4 ST. PAUL WATERWAY

Sediment Characteristics—Problem chemicals in St. Paul Waterway were mainly organic chemicals. 4-Methylphenol was selected as an indicator chemical. Approximately 118,000 square yards of sediments exhibited levels of 4-methylphenol that exceeded cleanup objectives. Contaminated sediments were capped in place in 1988. Habitat restoration in the intertidal zone was conducted during capping operations.

Source Characteristics—Historical discharges from what is now known as the Simpson Tacoma Kraft pulp mill was the major source of problem chemicals found in the sediments of St. Paul Waterway. The locations of existing businesses, industries, and discharges are presented in Appendix C. The primary historical source of contamination from the site appears to have been effluent from the wastewater treatment system. Extensive remedial action has occurred at the Simpson facility. In-plant process modifications that improved effluent quality and relocation of the secondary treatment outfall were completed in September 1988. Relocation of the outfall and consequent increase in the dilution ratio are predicted by Simpson to virtually eliminate sediment accumulation of any problem chemicals that have not been removed from the effluent stream by in-plant process modifications. Monitoring results will be used to verify this prediction.

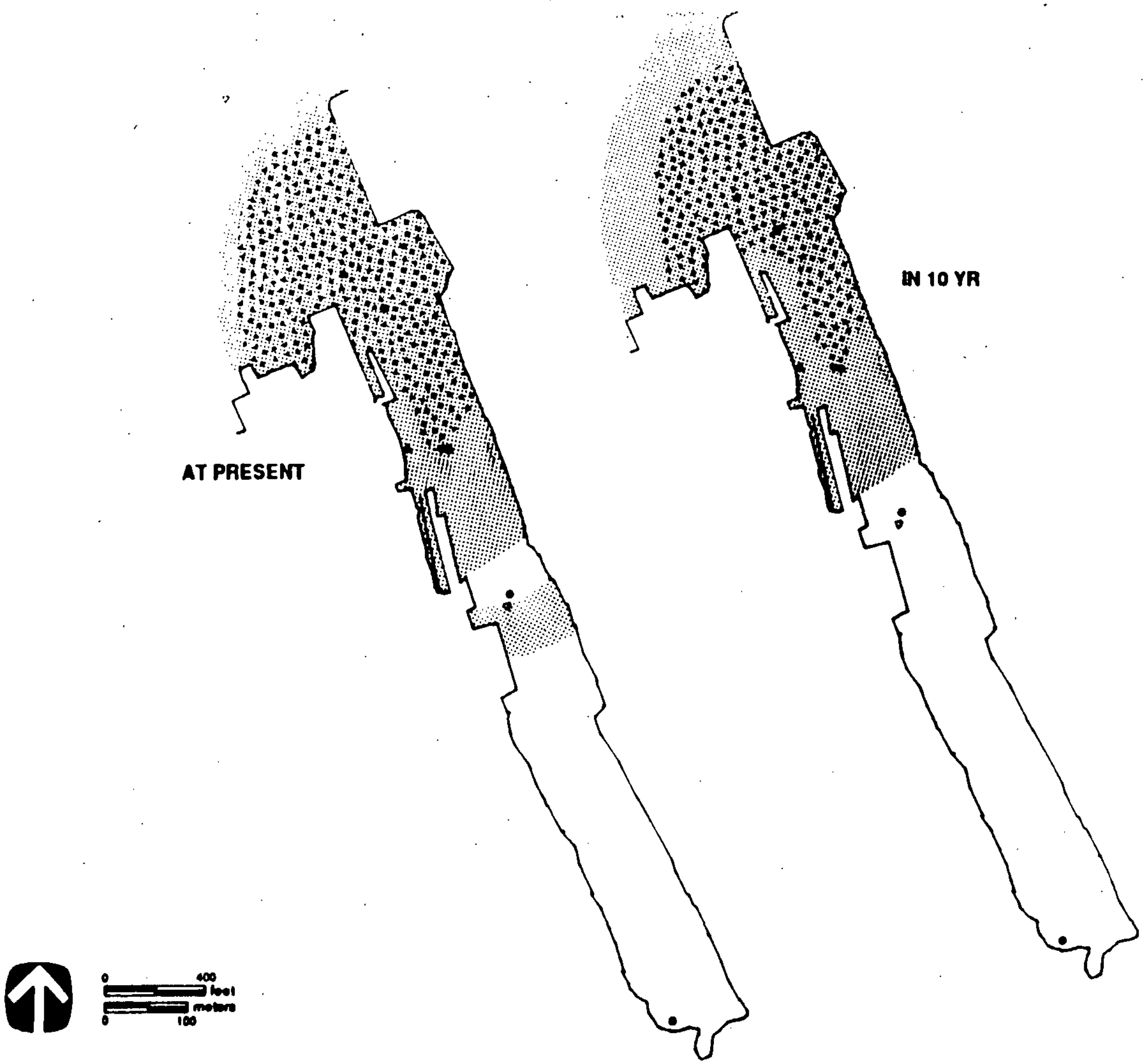
6.5 MIDDLE WATERWAY

Sediment Characteristics—Mercury and copper were selected as chemical indicators of the most severe sediment contamination. Approximately 126,000 square yards of sediments in this problem area exhibited chemical concentrations exceeding cleanup objectives. Implementation of source control measures is predicted to reduce this area to less than 114,000 square yards after 10 years (Figure 7).

Source Characteristics—Contamination in the sediments of Middle Waterway is attributed to maritime industries and storm drains. The locations of existing industries, businesses, and discharges are presented in Appendix C. Land use in the drainage basin is entirely commercial and industrial. Marine Industries Northwest and Cooks Marine Specialties are the two shipyards associated with problem metals in sediments in Middle Waterway (Tetra Tech 1985, 1988a). Metals from these sites are probably derived from sandblasting and painting. Both sites are located on property previously occupied by Foss Launch and Tug and by Peterson Boat, where similar activities were conducted dating back to the 1900s. The largest of the storm drains discharging to Middle Waterway is Storm Drain MD-200, which drains an area of approximately 80 acres and discharges to the head of the waterway. Storm Drain MD-200 has been identified as a probable source of problem organic chemicals in the head of the waterway. Several other storm drains discharge to Middle Waterway. In general, problem chemicals associated with these drains are poorly characterized, and the relationships among activities in the basin and problem chemicals observed in the sediments in Middle Waterway are not well understood.

6.6 HEAD OF CITY WATERWAY

Sediment Characteristics—HPAHs, cadmium, lead, and mercury were selected as chemical indicators of the most severe environmental contamination associated with biological effects.



Tetra Tech (1988a)

Middle Waterway Indicator Chemicals

AT PRESENT	
DEPTH (yd)	0.5
AREA (yd^2)	126,000
VOLUME (yd^3)	63,000
IN 10 YR	
DEPTH (yd)	0.5
AREA (yd^2)	114,000
VOLUME (yd^3)	57,000

▲ FEASIBILITY STUDY SEDIMENT PROFILE SURVEYS (1986)

● SEDIMENT SURVEYS CONDUCTED IN 1984

▼ SEDIMENT SURVEYS CONDUCTED BEFORE 1984 (1979-1981)

COPPER (AET = 390 mg/kg)

MERCURY (AET = 0.59 mg/kg)

Figure 7. Sediments in Middle Waterway not meeting sediment quality objectives for indicator chemicals at present and 10 years after implementing feasible source control

Approximately 230,000 square yards of sediments in this problem area exhibited chemical concentrations exceeding cleanup objectives. Implementation of source control measures was not predicted to effect rapid natural recovery (Figure 8).

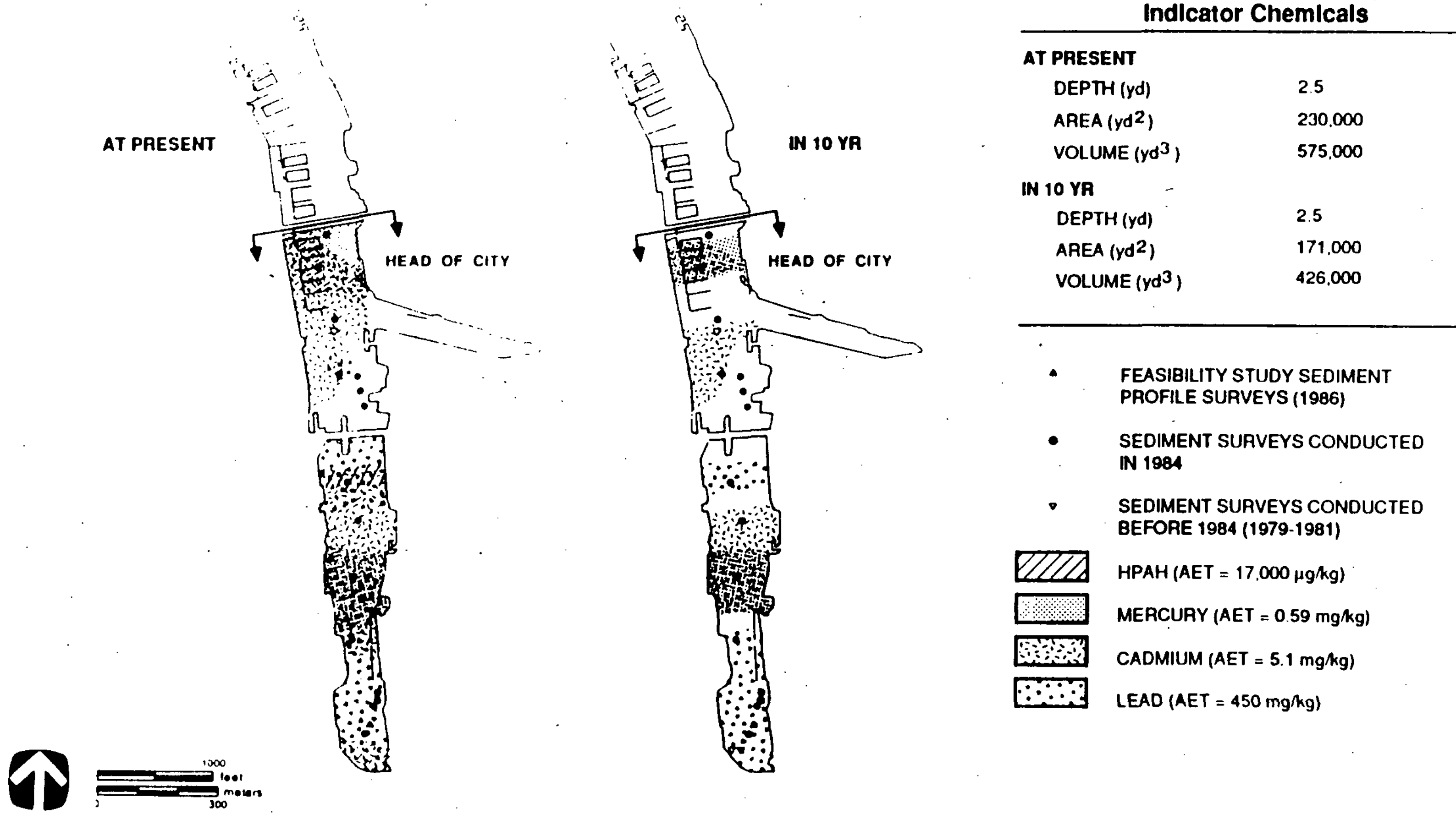
Source Characteristics—Contamination in the sediments at the Head of City Waterway is attributed to storm drains, maritime industries, and electroplating facilities. The locations of existing industries and businesses are presented in Appendix C. American Plating was identified as the most likely source of nickel contamination in a small area along the east shoreline of City Waterway, but appears to be a minor or negligible source of other metals in the waterway. Electroplating operations were conducted at the site between 1955 and 1986. The major mechanism transporting onsite contamination to the sediments is probably surface water runoff. Martinac Shipbuilding was associated with problem metals (especially copper and zinc) in sediments at the Head of City Waterway (Tetra Tech 1985, 1988a). Martinac, which has operated at the site since 1924, is involved primarily in design and construction of large commercial vessels, and some ship repair work is also conducted. Metals from the site are derived from sandblasting and painting operations. The Tacoma spur highway construction site is potentially associated with aromatic hydrocarbon contamination (i.e., PAHs, benzene, toluene) at the Head of City Waterway. A previous study (Hart Crowser 1984) reported extensive groundwater contamination at the site; however, the source of this contamination is unknown. Other potential sources of groundwater hydrocarbon contamination include an abandoned gasoline station at Puyallup and A streets, an equipment storage yard, a coal- and wood-powered electricity generating plant, and petroleum product and storage tanks (Tetra Tech 1988a).

Gradients in the concentration of contaminants in the sediments as well as known historical disposal practices indicate that the Nalley Valley and South Tacoma storm drains are major historical and possibly ongoing sources of organic matter and metals (e.g., lead) in the Head of City Waterway. The Nalley Valley storm drain serves approximately 2,800 acres to the south and east of the waterway. Commercial and industrial development in the basin is concentrated around the Interstate-5 and South Tacoma Way corridors. The South Tacoma storm drain serves 2,200 acres directly south of the head of the waterway. Land use in the basin is primarily residential, with commercial development concentrated in the northern portion of the drainage basin near the Interstate-5 corridor. These two storm drains are included in the ongoing pollution control effort underway by the city of Tacoma under the memorandum of agreement between the city of Tacoma, TPCHD, and Ecology. The Tacoma sewer utility is evaluating the feasibility of settling basins to control contaminant discharge from these drains. Storm Drain CI-230 serves approximately 530 acres consisting of a large part of the downtown Tacoma business district and a portion of the residential section west of the business district. Storm Drain CI-230, one of five major storm drains discharging to Commencement Bay waterways, is included in the ongoing pollution control effort implemented by the city of Tacoma under the memorandum of agreement between the city of Tacoma, TPCHD, and Ecology. Numerous other storm drains discharge to the Head of City Waterway. In general, problem chemicals associated with these drains are poorly characterized, and the relationships among activities in the basin and problem chemicals in the sediments are not well understood.

6.7 WHEELER-OSGOOD WATERWAY

Sediment Characteristics—The entire area of Wheeler-Osgood Waterway, approximately 22,000 square yards, contained problem chemicals in concentrations that exceed cleanup objectives. Implementation of source controls is not predicted to effect significant natural recovery within 10 years (Figure 9). HPAHs and zinc were selected as chemical indicators of the most severe sediment contamination.

Source Characteristics—Storm Drain CW-254 is the major source associated with problem chemicals in the sediments of Wheeler-Osgood Waterway. It is likely that problem chemical

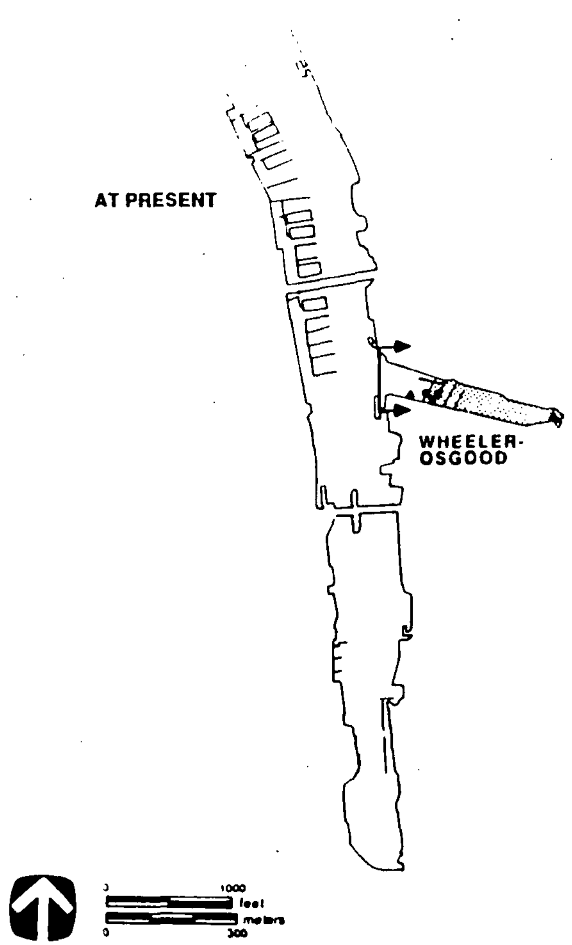


Head of City Waterway
Indicator Chemicals

AT PRESENT	
DEPTH (yd)	2.5
AREA (yd^2)	230,000
VOLUME (yd^3)	575,000
IN 10 YR	
DEPTH (yd)	2.5
AREA (yd^2)	171,000
VOLUME (yd^3)	426,000

Tetra Tech(1988a)

Figure 8. Sediments at the Head of City Waterway not meeting sediment quality objectives for indicator chemicals at present and 10 years after implementing feasible source control



Tetra Tech(1988a)

Wheeler-Osgood Waterway Indicator Chemicals

AT PRESENT	
DEPTH (yd)	0.5
AREA (yd^2)	22,000
VOLUME (yd^3)	11,000
IN 10 YR	
DEPTH (yd)	0.5
AREA (yd^2)	22,000
VOLUME (yd^3)	11,000

▲ FEASIBILITY STUDY SEDIMENT PROFILE SURVEYS (1986)

● SEDIMENT SURVEYS CONDUCTED IN 1984

• SEDIMENT SURVEYS CONDUCTED BEFORE 1984 (1979-1981)

HPAH (AET = 17,000 µg/kg)

ZINC (AET = 410 mg/kg)

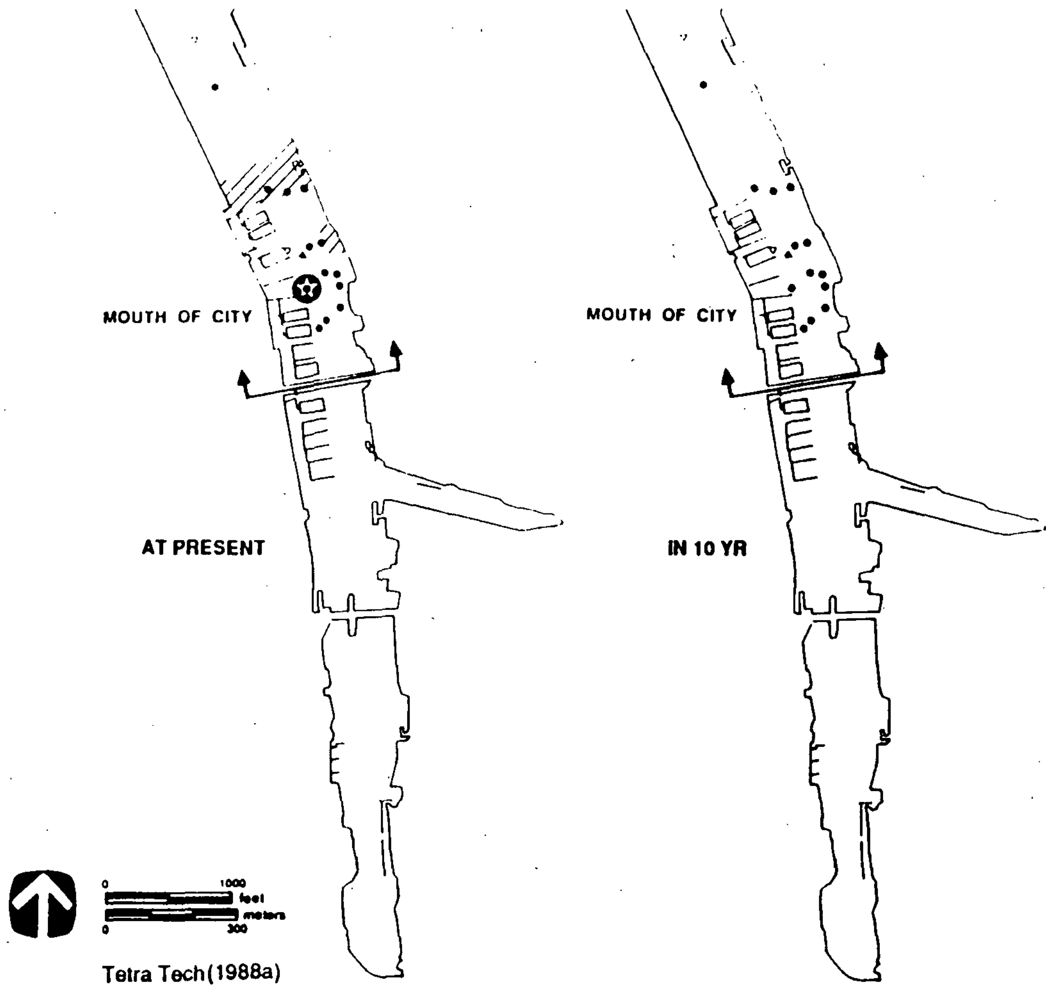
Figure 9. Sediments in Wheeler-Osgood Waterway not meeting sediment quality objectives for indicator chemicals at present and 10 years after implementing feasible source control

discharge was mainly historical. In the past, process wastes from Carstens Packing Company, a slaughterhouse and meat packing plant, were discharged directly to the waterway. Industrial facilities active in the drainage basin include Hygrade Food Products Corporation, Rainier Plywood Company, Kleen Blast, Northwest Container Corporation, Inc., and Chevron USA Incorporated. Storm Drain CW-254 is included in the ongoing pollution control effort implemented by the city of Tacoma under the memorandum of agreement between the city of Tacoma, TPCHD, and Ecology.

6.8 MOUTH OF CITY WATERWAY

Sediment Characteristics—An estimated 27,000 square yards of sediments at the Mouth of City Waterway exhibited chemical concentrations exceeding cleanup objectives. Implementation of source controls is predicted to eliminate this problem area entirely within 10 years (Figure 10). HPAHs and mercury were selected as chemical indicators of the most severe sediment contamination.

Source Characteristics—Contamination in sediments at the Mouth of City Waterway is attributed to petroleum storage facilities and unknown sources. The locations of existing industries and businesses are presented in Appendix C. The D Street petroleum facilities are an identified source of LPAHs in the Mouth of City Waterway, and they are the only identified source of problem chemicals in the waterway. Potential sources of other problem chemicals (e.g., mercury and HPAHs) in this portion of the waterway have not been verified (e.g., marina operations on the west shoreline). At the D Street petroleum facilities, spills and leakage of petroleum product have led to the groundwater contamination. Intermittent seepage of petroleum product has been observed along the City Waterway embankment since the early 1970s. An interceptor trench was installed in late 1987 to mitigate offsite transport of floating product.



Mouth of City Waterway Indicator Chemicals

AT PRESENT	
DEPTH (yd)	1
AREA (yd^2)	27,000
VOLUME (yd^3)	27,000
IN 10 YR	
DEPTH (yd)	1
AREA (yd^2)	0
VOLUME (yd^3)	0

- ▲ FEASIBILITY STUDY SEDIMENT PROFILE SURVEYS (1986)
- ● SEDIMENT SURVEYS CONDUCTED IN 1984
- ▼ SEDIMENT SURVEYS CONDUCTED BEFORE 1984 (1979-1981)
- ▨ HPAH (AET = 17,000 µg/kg)
- ✪ BIOLOGICAL EFFECTS OBSERVED FOR NON-INDICATOR COMPOUNDS

Figure 10. Sediments at the Mouth of City Waterway not meeting sediment quality objectives for indicator chemicals at present and 10 years after implementing feasible source control

7. SUMMARY OF SITE RISKS

CERCLA response actions at the CB/NT site as described in this Record of Decision are intended to protect the marine environment and human health related to the marine environment from current and potential exposure to hazardous substances at the site. To assess these risks at the CB/NT site, human health and environmental risk assessments were conducted as part of the remedial investigation. The risk assessments were used in the remedial investigation to characterize the magnitude of risks associated with exposure to contaminated sediments and to prioritize areas within the CB/NT site for remedial action. The results of the risk assessments were also used in the feasibility study to develop sediment cleanup guidelines to protect human health and the environment.

Releases of hazardous substances to the marine environment at the CB/NT site have resulted in contamination of bottom sediments in the waterways and along the Ruston-Pt. Defiance Shoreline. The human health and environmental risk assessments are based on exposure of marine biota to contaminated sediment and exposure of humans to contaminated seafood. Risks to marine biota were estimated based on field and laboratory testing of sediments at the CB/NT site. Human health risks were estimated by assessing the potential for health impacts caused by consumption of local seafood containing contaminants also found in sediments.

7.1 HUMAN HEALTH RISKS

7.1.1 General Strategy

Human health risks from seafood consumption at the CB/NT site were evaluated in a two-phase process:

1. Baseline human health risks were estimated for chemicals detected in fish and crab tissue samples from the CB/NT site and a reference area. These analyses were used to identify chemicals that accumulated in organism tissues and resulted in significant risks to seafood consumers. Chemicals posing significant risks were identified by calculating carcinogenic risk levels or by comparison with EPA's acceptable daily intake (ADI) values. Risks of seafood consumption at the CB/NT site were also compared with risks of seafood consumption in an uncontaminated reference area, Carr Inlet. Chemicals posing risk levels at the CB/NT site that were similar to those at the reference area were not considered for further site cleanup evaluation (i.e., it was not considered feasible to cleanup to less than reference levels).

2. Chemicals posing significant risks were further evaluated for determination of sediment cleanup levels that would reduce site risks to acceptable levels. For these analyses, tissue concentrations of contaminants in fish from the reference area were selected as the target levels. Therefore, the objective of this phase of the risk assessment was to identify sediment quality levels that would result in the attainment of reference levels of fish tissue contamination.

The uptake of contaminants in CB/NT site seafood was evaluated by chemical analysis of three kinds of tissue samples: English sole muscle tissue (i.e., fillets), English sole livers, and crab muscle tissue (legs and body meat). English sole and crabs were selected for study because they live near the bottom in close association with contaminated bottom sediments. Although other species may have higher or lower contaminant levels in some parts of Puget Sound, English sole provide a representative measure of contaminant uptake by fishes and were present in large numbers in the CB/NT study area. Fish livers are probably eaten by only a very small number of anglers. However, the uptake and retention of contaminants in fish liver tissue is much higher than in muscle tissue. Thus, the use of combined muscle tissue and liver tissue data was also appropriate as an assessment of maximum potential exposures to a small part of the angling public.

7.1.2 Identification of Chemicals of Concern

Contaminants of concern were identified by evaluating the concentrations in CB/NT biota and by a comparison of concentrations in seafood organisms from an uncontaminated reference area, Carr Inlet. Of the more than 100 chemicals analyzed for in CB/NT biological samples, only 16 organic chemicals were detected in English sole muscle tissue. Eleven organic chemicals were measured at sufficient frequencies and concentrations to be subjected to further evaluation: tetrachloroethene, ethylbenzene, hexachlorobenzene, 1,3-dichlorobenzene, hexachlorobutadiene, naphthalene, bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, di-n-octyl phthalate, DDE, and PCBs. Metals were detected in all samples, but the concentrations in CB/NT biota were similar to levels measured in Carr Inlet samples. However, arsenic was identified as a chemical of concern because of its widespread contamination of CB/NT sediments and because it is a suspected human carcinogen, even though it was not measured in biota at statistically significant levels above reference conditions.

PCBs were the most frequently detected chemicals in English sole and crab samples from the CB/NT site. For English sole, there was considerable variability in PCB concentrations among the waterways (Figure 11) and within the waterways. Maximum PCB levels in English sole muscle tissue were measured in Hylebos Waterway (1,300 μg/kg wet weight). Sole from Hylebos Waterway had an average PCB concentration of 332 μg/kg wet weight. This average level is approximately an order of magnitude higher than the PCB concentration measured in English sole from Carr Inlet (36 μg/kg wet weight). Other organic chemicals displayed more localized contamination in CB/NT biological samples and were generally less elevated with respect to Carr Inlet samples. For example, hexachlorobenzene and hexachlorobutadiene were detected only in English sole from Hylebos Waterway at concentrations similar to the analytical detection limits (10-40 μg/kg wet weight).

7.1.3 Baseline Risk Assessment

The baseline risk assessment described in the CB/NT remedial investigation included a site-specific exposure assessment. The exposure assessment for consumption of fish and crabs from the CB/NT site included two elements: 1) estimating the exposed population, and 2) estimating the rate of fish and crab consumption. A survey conducted by TPCHD (Pierce et al. 1987) indicated that there are 4,070 shore and boat anglers in the Commencement Bay area. The average family size of the angler group was estimated at 3.74 persons. Thus, assuming that all members of a family eat the angler's catch, the total exposed population would be approximately 15,200 persons. Information on the average catch per trip and frequency of angling trips indicated that fish consumption rates vary considerably among the exposed population. Estimated consumption rates ranged from 1 pound/year (1.2 grams/day) to 1 pound/day (453 grams/day). Approximately 0.2 percent of the exposed population (i.e., 30 persons) were estimated to consume Commencement Bay fish at the very high rate of 1 pound/day (453 grams/day). Only about 7 percent of the exposed population consumed greater than 1 pound/month (15 grams/day). Therefore, about 93 percent of the exposed group consumed 1 pound/month or less. These two consumption rates were used as estimates of 1) the maximum potential exposure of a very small part of the population (1 pound/day), and 2) the maximum exposure rate experienced by a high percentage of the population (1 pound/month). In comparison, a more recent survey of seafood consumption throughout Puget Sound (Tetra Tech 1988b) indicates that the mean consumption rate is about 0.027 pounds/day (12.3 grams/day) and the 95th percentile consumption rate is about 0.21 pounds/day (95 grams/day).

Health risks were estimated for consumers of CB/NT fish and shellfish on a chemical-by-chemical basis for carcinogens (e.g., PCBs and arsenic) and noncarcinogens (e.g., copper and mercury). For carcinogens, risks were calculated by multiplying EPA's cancer potency factor for

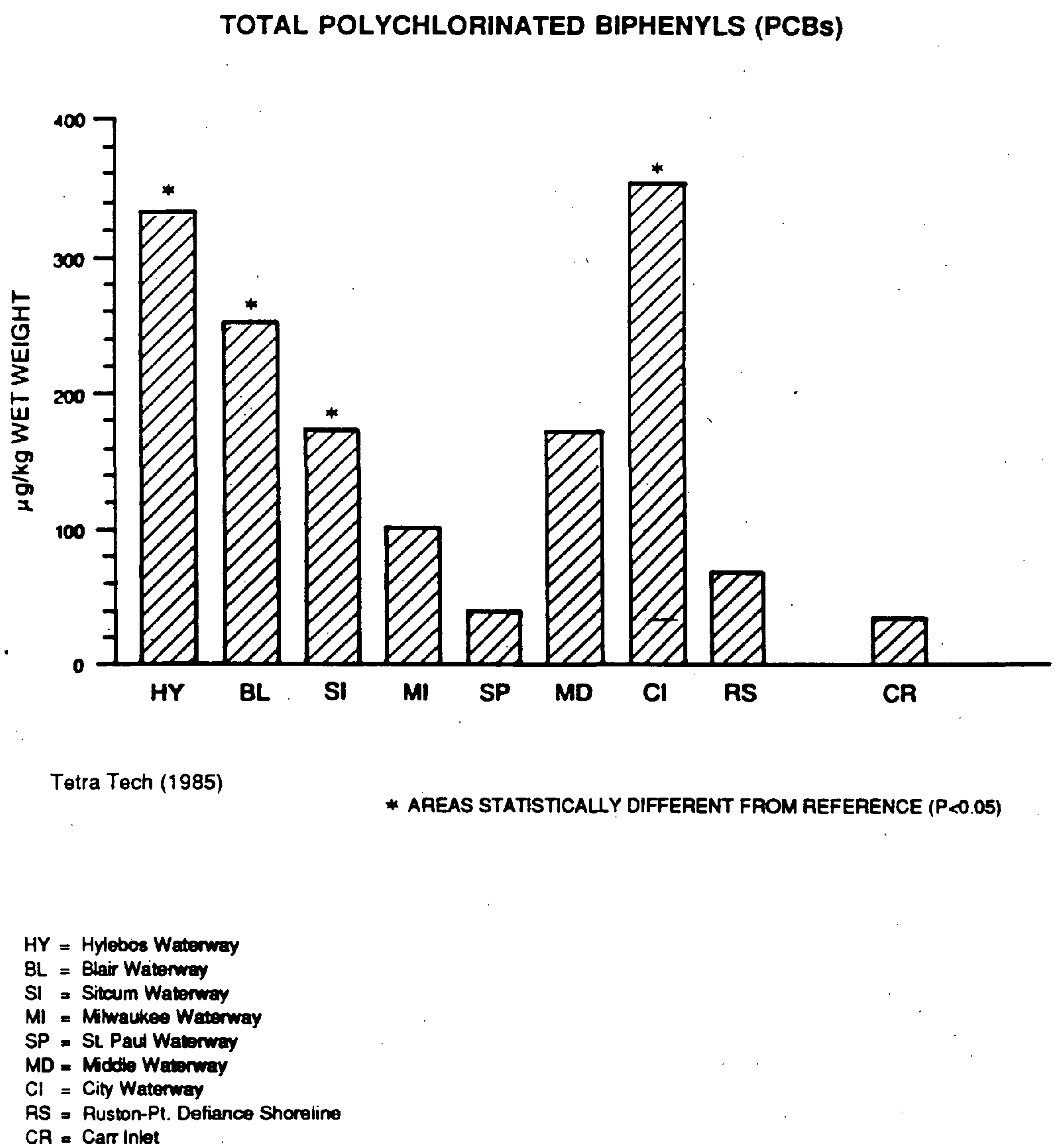


Figure 11. Concentrations of total PCBs in English sole muscle tissue

each chemical by the estimated intake of that chemical. The resultant individual lifetime cancer risks are expressed in scientific notation (e.g., 1×10^{-6}). An estimated risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to the carcinogen over a 70-year lifetime (under the specific exposure conditions assumed at the site). EPA generally considers excess risks in the range of 10^{-4} to 10^{-7} as acceptable; however, the 10^{-6} level is used as a point of departure for setting cleanup levels under CERCLA response actions when promulgated criteria are not available. Potential concern for noncarcinogens was evaluated by comparing the estimated lifetime intake rate of a chemical with EPA's ADI value for that chemical.

The first step in the risk assessment as described in the CB/NT remedial investigation was to calculate the individual lifetime risks for ingestion of carcinogens in fish muscle tissue. For the purposes of this risk assessment, the average concentration of each chemical in English sole from the study area was used to calculate exposure. Based on these calculations, only six chemicals were predicted to result in a risk $>10^{-6}$ at the maximum fish consumption rate of 1 pound/day (Table 3) and only PCBs and arsenic had predicted risk levels greater than 1×10^{-4}. At a fish consumption rate of 1 pound/month, only PCBs and arsenic would exceed the 10^{-6} risk level.

For PCBs and arsenic, the risks of consuming crabs from the CB/NT site were approximately the same as the risks of eating fish. All other carcinogens measured in crab muscle resulted in predicted risks less than 10^{-6} at the maximum consumption rate of 1 pound/day. No site-specific data were available for crab consumption rates. Therefore, the consumption rates for fish were used in the crab risk assessment.

Consumption of PCBs in fish livers could result in a relatively high individual lifetime risk of 2×10^{-2} for individuals in the maximum fish consumption group (Table 4). The actual consumption of fish livers is unknown; therefore, this estimate was based on the assumption that the amount of fish liver consumed was proportional to the liver weight relative to total fish weight (i.e., 0.12).

For noncarcinogens, three metals (antimony, lead, and mercury) were present in fish muscle tissue in concentrations that would exceed the ADI values at the very high consumption rate of 1 pound/day. However, the ADI values would also be exceeded for fish from Carr Inlet at the 1 pound/day consumption rate. Limiting consumption of fish to 0.5 pound/day would result in exposure below the ADI values for all three metals. Bioaccumulation data indicated that sediment contamination by metals in Commencement Bay was not resulting in significantly increased tissue levels for metals. Therefore, risks of noncarcinogens in fish tissue was not evaluated further in estimating sediment cleanup levels. Moreover, source control and sediment remediation or recovery throughout the site is expected to reduce even this small excess risk of metals to insignificant levels.

The baseline risk assessments conducted for the CB/NT site indicated that the most significant human health risks are associated with elevated concentrations of PCBs in the tissues of resident seafood. Arsenic was not subjected to further evaluation relative to human health because of its lower risk level and because arsenic concentrations in CB/NT fish are similar to concentrations in fish from the reference area.

7.1.4 Relationship to Sediment Quality Objectives

The next step in the risk assessment was to evaluate the relationship between sediment contamination and fish tissue contamination so that a PCB cleanup level could be evaluated for its effectiveness in reducing risks to seafood consumers. Details of the quantitative methods used to estimate sediment cleanup levels to protect human health are provided in Tetra Tech (1988a). The calculation of a sediment cleanup level for PCBs to protect human health was established in relation to reference conditions, assuming that more stringent cleanup levels would be infeasible. The calculation therefore involved three key determinations and assumptions:

TABLE 3. ESTIMATED INDIVIDUAL LIFETIME RISKS FROM EATING FISH MUSCLE TISSUE CONTAINING ORGANIC COMPOUNDS

Chemical	Average Concentration (wet weight)	Consumption Rate	
		1 pound/day	1 pound/month
PCBs	210 μg/kg	6×10^{-3}	2×10^{-4}
Arsenic	4.1 mg/kg	4×10^{-4}	1×10^{-5}
Hexachlorobenzene	11 μg/mg	1×10^{-4}	4×10^{-6}
Hexachlorobutadiene	40 μg/kg	2×10^{-5}	7×10^{-7}
Bis(2-ethylhexyl)phthalate	194 μg/mg	2×10^{-5}	6×10^{-7}
Tetrachloroethene	66 μg/kg	1×10^{-5}	5×10^{-7}

TABLE 4. PROJECTED LIFETIME CANCER RISKS FOR PCBs AND ARSENIC

Consumption Frequency (1 pound)	Fish Intake (grams/day)	Exposure (mg/kg/day)	Individual Risk	Exposed Population
PCBs				
Daily	453.0	1.36×10^{-3}	5.90×10^{-3}	30
Weekly	64.7	1.94×10^{-4}	8.42×10^{-4}	1,005
Monthly	15.1	4.53×10^{-5}	1.97×10^{-4}	1,735
Bimonthly	7.4	2.22×10^{-5}	9.63×10^{-5}	1,111
Twice/year	2.5	7.50×10^{-6}	3.26×10^{-5}	2,618
Yearly	1.2	3.60×10^{-6}	1.56×10^{-5}	8,721
Total				15,220
Arsenic				
Daily	453.0	3.16×10^{-5}	4.42×10^{-4}	30
Weekly	64.7	4.51×10^{-6}	6.31×10^{-5}	1,005
Monthly	15.1	1.05×10^{-6}	1.47×10^{-5}	1,735
Bimonthly	7.4	5.16×10^{-7}	7.22×10^{-6}	1,111
Twice/year	2.5	1.74×10^{-7}	2.44×10^{-6}	2,618
Yearly	1.2	8.37×10^{-6}	1.17×10^{-6}	8,721
Total				15,220

- **Fish Tissue Concentration Objective**: The average PCB level measured in English sole from the Carr Inlet reference area was selected as the target tissue concentration following sediment cleanup at the CB/NT site. This PCB level in fish tissue (36 μg/kg) results in an individual lifetime risk in the 10^{-5} range for a seafood consumption rate of 1 pound/month.
- **Reference Sediment Concentrations**: Applicable sediment remedial technologies (e.g., removal or capping) were assumed to result in the attainment of background sediment PCB levels (20 μg/kg) at the actual cleanup site by either dredging and exposing clean sediments, or by capping with clean material.
- **Method of Quantitative Relationship**: The equilibrium partitioning method was selected to determine quantitative relationships between sediment contamination and fish tissue contamination. This method assumes that a thermodynamic equilibrium exists between contaminants in sediments and contaminants in fish tissue, and that the relationship can be described quantitatively based on the distribution of a pollutant as a function of fish lipids and sediment organic carbon. Because of fish movement and the time required to reach equilibrium, it is also assumed that the equilibrium fish tissue concentrations are representative of the average sediment PCB levels in a waterway.

Application of the selected equilibrium partitioning equation to the CB/NT data indicated that a sediment PCB level of 30 μg/kg would result in attainment of a fish tissue concentration of 36 μg/kg wet weight. Based on this calculation, alternative sediment cleanup objectives ranging from 50 to 1,000 μg/kg were evaluated for PCBs according to the following iterative method with the intent of achieving an average fish tissue concentration for PCBs similar to reference conditions:

1. An average reference sediment PCB concentration of 20 μg/kg was substituted for all measured sediment concentrations exceeding a particular cleanup objective (e.g., 1,000 μg/kg)
2. An overall post-cleanup sediment concentration was calculated as the geometric mean of the post-cleanup data set following substitution of all values greater than a particular cleanup objective (e.g., 1,000 μg/kg) with values of 20 μg/kg
3. The mean residual sediment concentration was used to calculate the predicted mean fish tissue concentration using the equilibrium partitioning model
4. The mean predicted fish tissue concentration was compared to the fish tissue concentration objective (i.e., 36 μg/kg).

Compilation and evaluation of these results indicated that a PCB sediment cleanup level of 150 μg/kg would result in an average post-cleanup sediment concentration of 30 μg/kg for Hylebos Waterway or for the CB/NT site in general. This cleanup level would also result in attainment of fish PCB levels similar to those in Puget Sound reference areas. The health risks of seafood consumption from remediated waterways would be about 4×10^{-5} for a seafood consumption rate of 12.3 g/day, and therefore be comparable to the risks in reference areas.

7.2 ENVIRONMENTAL RISK ASSESSMENT

7.2.1 General Strategy

The CB/NT investigations have had a major focus on environmental risks because of the adverse biological effects documented in past studies of the area and because of the high potential for exposure of marine biota to sediment-associated contaminants. The historical data for the area indicated that sediments were contaminated by a wide variety of chemicals, with contamination patterns and potential sources differing considerably among the waterways. Because of this site complexity and the lack of available regulatory standards or guidelines for establishing cleanup criteria for contaminated sediments, a decision-making approach was developed specifically for the CB/NT investigations that included characterization of sediment problems, development of sediment quality objectives, identification of problem chemicals, and definition of problem areas requiring sediment remediation.

The environmental risk assessment framework developed for the remedial investigation incorporates a preponderance-of-evidence approach that is implemented in a stepwise manner to identify and rank toxic problem areas and problem chemicals.

Ideally, sediment quality objectives and sediment management decisions would be supported by definitive cause and effect information relating specific chemicals to biological effects in various aquatic organisms and to quantifiable human health risks. However, very little information of this type is currently available, and it is unlikely that additional information will be available in the near future. In the interest of protecting human health and the environment, regulatory agencies must proceed with sediment management decisions based on the best information available.

The application of the ecological risk assessment approach for the CB/NT site was based on three important premises. First, it was assumed that the development of cleanup objectives to define problem sediments and chemicals would require the analysis of site-specific data collected as part of the remedial investigation. Second, it was assumed that no single chemical or biological indicator could be used to define problem sediments. Therefore, the risk assessment would be based on several independent measures of contamination and biological effects. Third, it was assumed that adverse biological effects are linked to sediment contamination and that these links could be characterized empirically. Thus, a preponderance of field and laboratory evidence linking contaminant concentrations with adverse biological effects could be used to establish an empirical relationship despite the lack of information establishing cause and effect relationships.

The preponderance-of-evidence approach required the selection of several measurements to serve as indicators of contamination and biological effects at the CB/NT site. The following five groups of indicator variables were selected:

- **Sediment contamination**—Concentrations of chemicals and chemical groups
- **Bioaccumulation**—Contaminant concentrations in English sole
- **Sediment toxicity**—Acute mortality of amphipods and abnormalities in oyster larvae
- **Benthic infauna**—Abundances of major taxa
- **Fish histopathology**—Prevalences of liver lesions in English sole.

7.2.2 Identification of Problem Chemicals

The CB/NT investigations indicated that area sediments were contaminated by numerous inorganic and organic chemicals at levels substantially above Puget Sound reference conditions. Because of the extensive list of sediment contaminants, a procedure was developed to identify and rank problem chemicals so that source and cleanup evaluations could be focused on the chemicals posing the greatest environmental or public health risk. The overall identification of problem chemicals involved a three-step process. In the first step, historical data for the site were reviewed to select a suite of chemicals to be analyzed in the remedial investigation. This suite of chemicals included EPA priority pollutants, many EPA Hazardous Substance List compounds, and several organic compounds that are not on the EPA lists. Following the remedial investigation sampling, a group of chemicals of concern was then identified from the overall list of analytes. Chemicals of concern were defined as chemicals with concentrations exceeding all Puget Sound reference conditions. These chemicals are not necessarily considered problem chemicals because sediments may be contaminated above reference conditions without exhibiting toxicity or biological effects. In the final step, the chemicals of concern were evaluated for their relationship to biological effects. The objective of this step was to define problem chemicals so that source identification and remedial alternatives analyses could be focused on a limited suite of chemicals that apparently posed the greatest environmental risk. Problem chemicals were defined as those chemicals whose concentration exceeded the apparent effects threshold (AET) in the problem area. Because the AET was defined as the contaminant concentration above which toxicity or benthic effects are always observed, chemicals present in concentrations above this threshold are likely contributors to observed biological effects.

Problem chemicals were further ranked according to their association with toxicity or biological effects. Based on this approach, three priorities of problem chemicals were given for each problem area. The highest priority (Priority 1) chemicals were defined as those present above an AET in a problem area and that also exhibited a concentration gradient corresponding to observed changes in sediment toxicity or benthic effects. For example, strong linear relationships were found between sediment toxicity and PCB concentrations in Hylebos Waterway and between sediment toxicity and 4-methylphenol concentrations in St. Paul Waterway. Other contaminants were found at levels above AET in these problem areas, but none displayed these strong relationships with sediment toxicity. Therefore, these two chemicals were given the highest priority for source evaluation and cleanup actions because of their demonstrated correspondence with observed toxicity. Priority 1 chemicals included:

- Mercury, lead, zinc, and arsenic
- PCBs, 4-methylphenol, HPAHs, and LPAHs.

Priority 2 chemicals were defined as those that occurred above the AET in the problem area but showed no particular relationship with effects gradients (or insufficient data were available to evaluate their correspondence with gradients). Chemicals with concentrations above the AET only at nonbiological stations were therefore placed no higher than Priority 2 because of the lack of biological data. These chemicals included:

- Cadmium, nickel, and antimony
- Hexachlorobutadiene, chlorinated benzenes, chlorinated ethenes, phenol, 2-methylphenol, N-nitrosodiphenylamine, dibenzofuran, selected phthalate esters, and selected tentatively identified compounds (e.g., 2-methoxyphenol).

Finally, chemicals with concentrations above AET at only one station within the problem area were assigned Priority 3. Problem chemicals for problem areas that were small hotspots of sediment contamination usually fell into this category.

7.2.3 Identification of Problem Areas

A series of simple indices was developed for each of the five indicators for contamination, toxicity, and biological effects to enable ranking of areas based on the relative magnitude of observed contamination and effects. These indices were defined in the general form of a ratio between the value of a variable at the CB/NT site and the value of the variable at a reference site. The indicator ratios were structured so that the value of the index increased as the deviation from reference conditions increased. Thus, each ratio was termed an elevation above reference (EAR) index. The environmental contamination and effects indicators (EAR) were used to compare the entire CB/NT study area and for individual waterways with individual sampling stations or groups of stations (i.e., waterway segments) as the study units.

Chemical contamination of CB/NT sediments was very uneven. Some chemicals [e.g., arsenic, copper, 4-methylphenol, and benzo(a)pyrene] were measured at concentrations exceeding 1,000 times reference levels. Biological effects were also highly varied among study areas. For example, amphipod mortality reached 95-100 percent at two sites, while mortalities in several other areas were indistinguishable from reference levels (7-25 percent). Similarly, analyses of benthic infauna indicated severe stress, as evidenced by very low abundances, at some sampling stations and apparently normal benthic assemblages at other sites. English sole were very abundant in the

CB/NT waterways. However, 25-40 percent of the sole from several waterways had one or more serious liver abnormalities, including cancers and precancerous conditions. Only about 7 percent of reference area sole had these liver abnormalities.

Toxic problem areas were defined as those areas with sufficient evidence of contamination and biological effects to warrant the evaluation of contaminant sources and possible remedial alternatives. The identification of these problem areas required the specification of criteria incorporating combinations of contamination and effects indices that would result in problem area identification. It was assumed that an area or segment would require no action unless at least one of the indicators of contamination, toxicity, or biological effects was significantly elevated above reference conditions. Final prioritization of problem areas for remedial action was determined based on three additional criteria:

- Environmental significance (i.e., the number and magnitude of significant contaminant and effects indices)
- Spatial extent of contamination
- Confidence in source identification.

Based on these criteria, nine discrete areas of sediment contamination were identified in the feasibility study as priority problem areas warranting further evaluation and response under Superfund (Figure 12). Overall, these priority problem areas displayed the following characteristics: multiple biological effects and significantly elevated chemicals, relatively large spatial extent, and one or more identified sources of contamination.

7.2.4 Relationship to Sediment Quality Objectives

The next step in the remedial investigation/feasibility study process was to evaluate the relationship between sediment contamination and biological effects so that measurable sediment quality objectives could be defined for both sediment chemistry and sediment biology. Details of the decision-making process used to select a method for evaluating sediment toxicity as it relates to biological effects are provided in Tetra Tech (1988a) and PTI (1989). As part of the remedial investigation/feasibility study, sediment quality objectives were required that could be used to:

- Identify problem chemicals in sediments
- Identify sources associated with problem chemicals
- Establish spatial designation of problem areas, especially in areas where site-specific biological testing results were not available.

Several approaches to sediment quality objectives based on laboratory, field, and theoretical relationships were evaluated for application to the CB/NT site. Approaches evaluated included reference areas, screening level concentrations, AET, and equilibrium partitioning. Based on consideration of management and technical criteria and on results of a verification exercise with field-collected data, the AET approach was selected and confirmed as the preferred method for developing sediment quality values in the CB/NT area. An AET is the sediment concentration of a chemical above which statistically significant ($P \leq 0.05$) biological effects are always observed in the data set used to generate AET values. In other words, if any chemical exceeds its AET for a particular biological indicator, then an adverse biological effect is predicted for that indicator. Alternatively, if all chemical concentrations are below their AET, then no adverse effects are predicted. The AET approach can be used to provide chemical-specific sediment quality values for the greatest number and widest range of chemicals of concern in Commencement Bay and throughout Puget Sound. AET can also be developed for a range of biological indicators, including laboratory-controlled bioassays and *in situ* benthic infaunal analyses. An additional advantage of using existing AET for the CB/NT site is that the remedial investigation data constitute a relatively large proportion of the total data set used to generate AET values. The AET approach has also been selected for application in other Puget Sound regulatory programs.

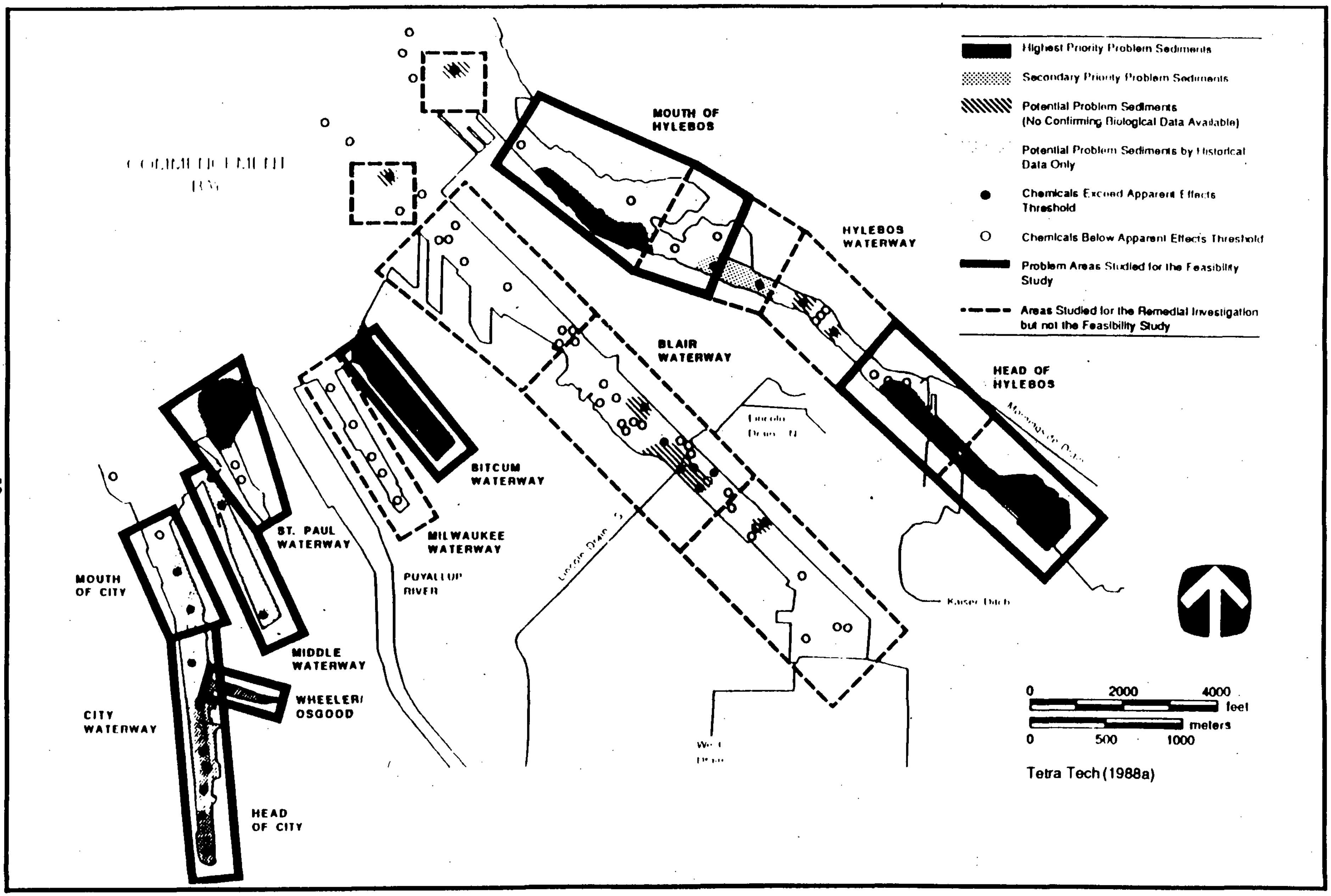


Figure 12. Relationship between problem areas identified during the remedial investigation and those studied for the feasibility study

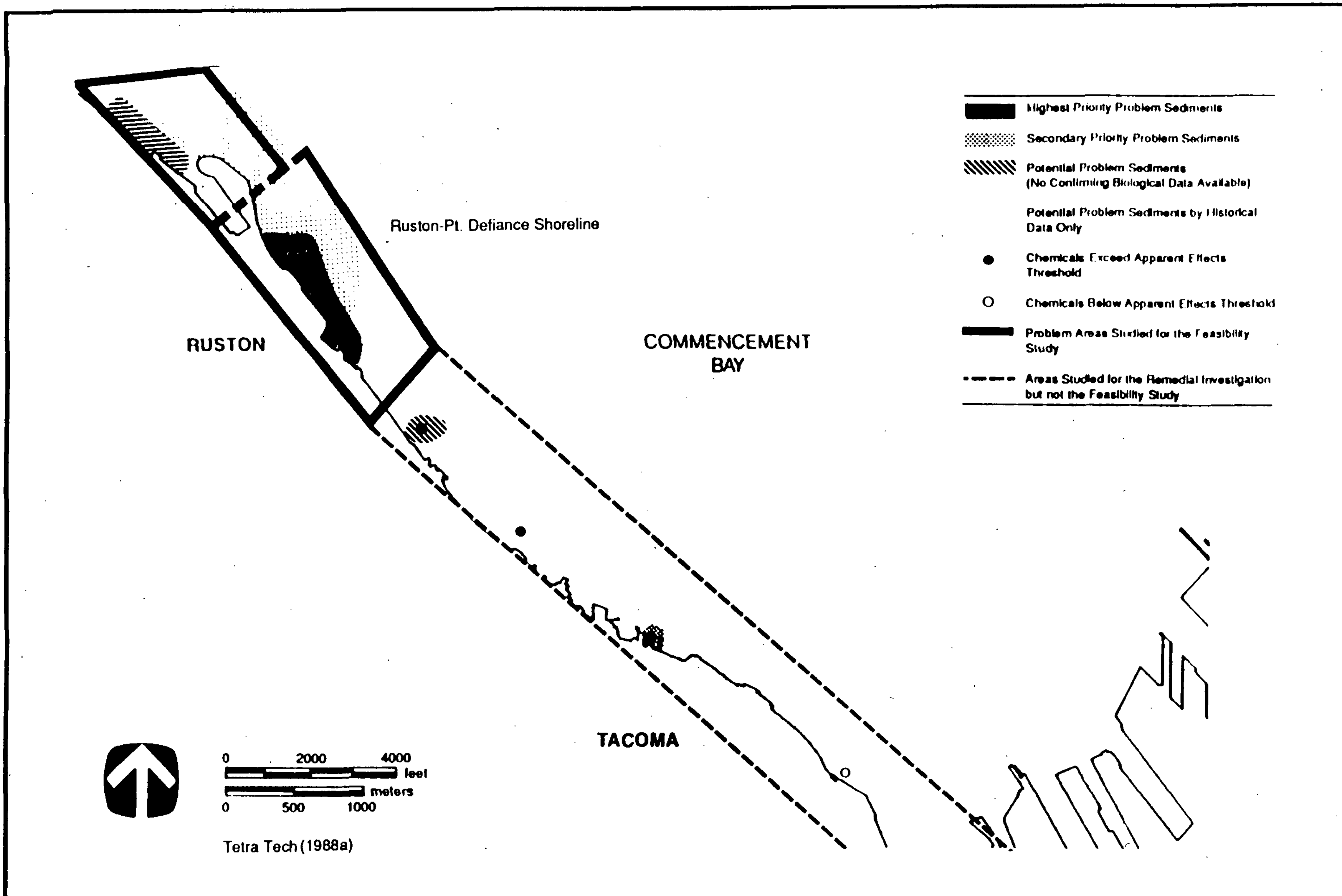


Figure 12. (Continued)

The calculation of AET for each chemical and biological indicator is straightforward:

1. Collect "matched" chemical and biological effects data at many sampling stations, including potentially impacted sites and reference areas.
2. Identify impacted and nonimpacted stations based on statistical comparisons with reference station conditions.
3. Identify AET using only nonimpacted stations. For each chemical and biological indicator, the AET is identified as the highest detected concentration among sediment samples that do not exhibit statistically significant effects.

A pictorial representation of the AET approach applied to a data set for two example chemicals is presented in Figure 13. For each chemical, the ranges of significant and nonsignificant sediment toxicity results are shown along a concentration gradient. For each chemical, the AET is shown as the highest concentration where no significant toxicity was measured (i.e., the top bar for each chemical). Above this concentration for each chemical, toxicity was always measured (solid part of lower bar).

During the remedial investigation, AET were generated for three biological effects (amphipod mortality, oyster larvae abnormality, and benthic infauna abundances) for a data set of 50-60 stations. Following the remedial investigation, the AET data set was expanded considerably by the addition of other synoptic data sets from various areas in Puget Sound. The AET data set used in the feasibility study to establish sediment cleanup goals consisted of 334 stations, and included data from other areas of Puget Sound. A list of AET used to define the sediment quality objectives for the CB/NT feasibility study is provided in Table 5. These values represent the lowest AET for the three biological effects indicators.

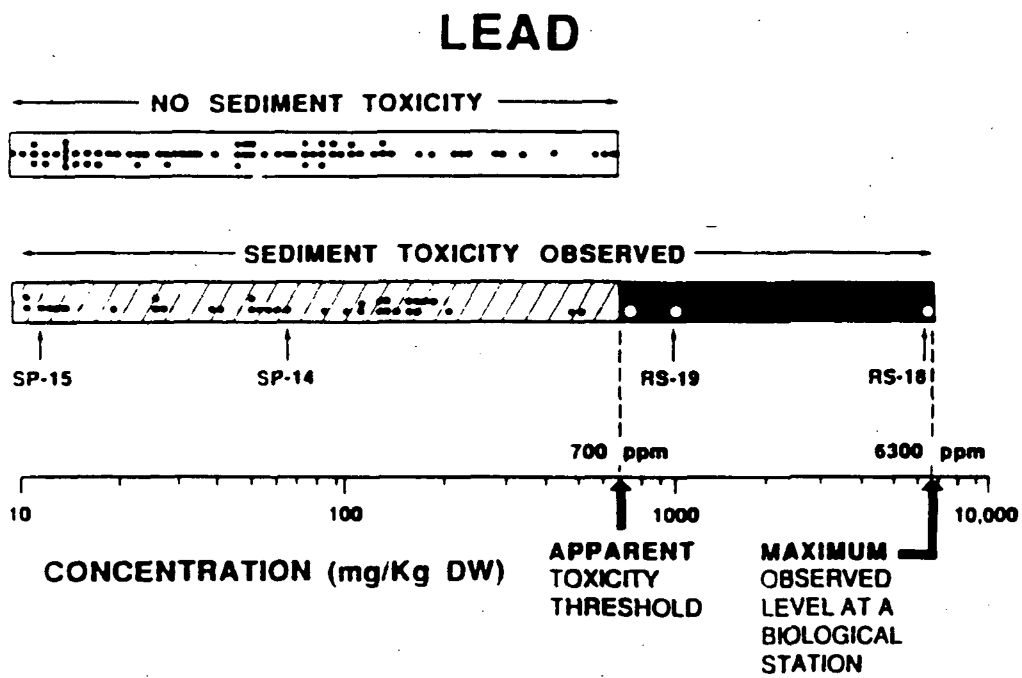
The three biological effects indicators used to define AET-derived sediment quality objectives for the CB/NT feasibility study were selected based on their sensitivity to sediment contamination, availability of standard protocols, and ecological relevance. The resultant AET are applicable to a wide range of relevant biological effects, thereby providing protection against a wide range of impacts.

Benthic infauna are valuable indicators because they live in direct contact with the sediments, they are relatively stationary, and they are important components of estuarine ecosystems. If sediment-associated impacts are not present in the infauna, then it is unlikely that such impacts are present in other biotic groups such as fishes or plankton.

The test species used in amphipod toxicity tests (*Rhepoxynius abronius*) resides in Puget Sound and is a member of a crustacean group that forms an important part of the diet of many estuarine fishes. Amphipods are generally pollution sensitive, and species such as *R. abronius* have a high pollutant exposure potential because they burrow into the sediment and feed on sediment material. The oyster larvae bioassay uses a test species (*Crassostrea gigas*) that resides in Puget Sound and supports commercial and recreational fisheries. The life stages tested (embryo and larva) are very sensitive stages of the organism's life cycle. The primary endpoint is a sublethal change in development that has a high potential for effecting larval recruitment.

7.3 MITIGATING FACTORS

Assessment of chemical contamination and biological effects at the CB/NT site indicated the presence of significant environmental and human health risks in several areas. Evaluation of the nature, extent, and magnitude of contamination and biological effects at the CB/NT site indicates that the primary mitigation factor influencing sediment remediation decisions is natural recovery of the sediment environment.



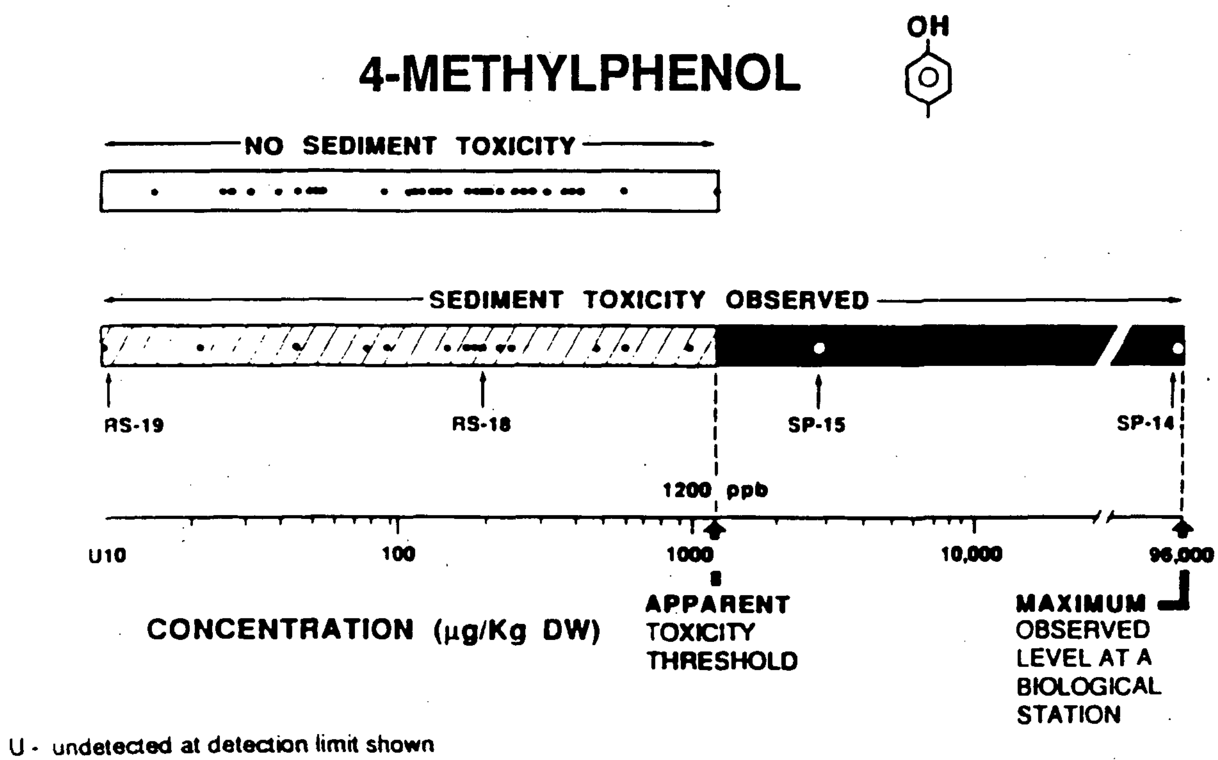


Figure 13. The AET approach applied to sediments tested for lead and 4-methylphenol concentrations and toxicity response during bioassays

TABLE 5. SEDIMENT QUALITY VALUES REPRESENTING THE SEDIMENT CLEANUP OBJECTIVES RELATED TO ENVIRONMENTAL RISKS

Chemical	Sediment Cleanup Objective[a]
Metals (mg/kg dry weight; ppm)	
Antimony	150[B]
Arsenic	57[B]
Cadmium	5.1[B]
Copper	390[L]
Lead	450[B]
Mercury	0.59[L]
Nickel	>140[A,B]
Silver	6.1[A]
Zinc	410[B]
Organic Compounds (μg/kg dry weight; ppb)	
Low molecular weight PAH	5,200[L]
Naphthalene	2,100[L]
Acenaphthylene	1,300[A,B]
Acenaphthene	500[L]
Fluorene	540[L]
Phenanthrene	1,500[L]
Anthracene	960[L]
2-Methylnaphthalene	670[L]
High molecular weight PAH	17,000[L]
Fluoranthene	2,500[L]
Pyrene	3,300[L]
Benz(a)anthracene	1,600[L]
Chrysene	2,800[L]
Benzofluoranthenes	3,600[L]
Benzo(a)pyrene	1,600[L]
Indeno(1,2,3-c,d)pyrene	690[L]
Dibenzo(a,h)anthracene	230[L]
Benzo(g,h,i)perylene	720[L]
Chlorinated organic compounds	
1,3-Dichlorobenzene	170[A,L,B]
1,4-Dichlorobenzene	110[B]
1,2-Dichlorobenzene	50[L,B]
1,2,4-Trichlorobenzene	51[A]
Hexachlorobenzene (HCB)	22[B]
Total PCBs	1,000[B,*]

TABLE 5. Continued

Chemical	Sediment Cleanup Objective[a]
Phthalates	
Dimethyl phthalate	160[L]
Diethyl phthalate	200[B]
Di-n-buytl phthalate	1,400[A,L]
Butyl benzyl phthalate	900[A,B]
Bis(2-ethylhexyl)phthalate	1,300[B]
Di-n-octyl phthalate	6,200[B]
Phenols	
Phenol	420[L]
2-Methylphenol	63[A,L]
4-Methylphenol	670[L]
2,4-Dimethylphenol	29[L]
Pentachlorophenol	360[A]
Miscellaneous extractables	
Benzyl alcohol	73[L]
Benzoic acid	650[L,B]
Dibenzofuran	540[L]
Hexachlorobutadiene	11[B]
N-nitrosodiphenylamine	28[B]
Volatile organics	
Tetrachloroethene	57[B]
Ethylbenzene	10[B]
Total xylenes	40[B]
Pesticides	
p,p'-DDE	9[B]
p,p'-DDD	16[B]
p,p'-DDT	34[B]

[a] Option 2 - Lowest AET among amphipod, oyster, and benthic:

A - Amphipod mortality bioassay
L - Oyster larvae abnormality bioassay
B - Benthic infauna
* - The sediment quality objective for human health has been established at 150 ppb for PCBs at the CB/NT site according to a method combining equilibrium partitioning and risk assessment methods.

7.3.1 Natural Recovery Process

Natural recovery of contaminated sediments is the process whereby the magnitude and extent of sediment contamination in the upper sediment layers is reduced over a period of time following significant reduction or elimination of contaminant sources that adversely impact sediment quality. Reductions in surficial sediment contamination are expected to result in corresponding reductions in environmental and public health risks.

The overall process of natural recovery of sediments is dependent on several specific processes:

- **Sediment accumulation and mixing**: Once existing sources are reduced or eliminated, cleaner sediment would tend to bury the more contaminated sediments. Biological and physical processes would also tend to mix the recently deposited, cleaner sediments with the contaminated sediments in the near-surface layers.
- **Biodegradation**: Microbial assemblages in the sediments break down many contaminants into less toxic forms.
- **Diffusive loss**: Contaminants adsorbed onto sediment particles may tend to dissolve into interstitial water (i.e., water in the sediments) then diffuse into the overlying water column.

These processes act at very different rates in reducing sediment contamination. The resultant recovery rates are also very site-specific, depending on factors such as sediment deposition rates, biological mixing activity, degrees of physical disturbance, biological productivity, and oxygenation of the sediments.

7.3.2 Relationship to Sediment Quality Objectives

In the feasibility study (Tetra Tech 1988a), natural recovery was evaluated as a potential means of achieving the sediment quality objective for the site. The advantages of natural recovery include:

- Long-term mitigation of environmental and health risks
- Avoidance of the potential adverse impacts of sediment cleanup operations (e.g., disturbance of existing benthic communities, redistribution of contaminants during dredging operations)
- Reduction in volumes requiring remediation with coincident increases in the feasibility of implementing sediment remedial activities
- Reductions in cost.

The disadvantages of natural recovery as an element of the selected remedy include:

- The continued risk of exposure during the natural recovery period
- Uncertainties regarding predictions of feasible levels of source control and estimated recovery rates
- Concern about the possibility of disturbance to a relatively thin natural cap (e.g., several inches of clean sediment) by physical (e.g., ship scour, wave erosion) and/or biological (e.g., burrowing) processes.

A mathematical model was developed in the feasibility study to quantitatively assess natural recovery in the CB/NT problem areas. The Sediment Contamination Assessment Model (SEDCAM) is a mass balance equation that predicts the sediment concentration of contaminants in relation to source loading, sedimentation rates, sediment mixing, biodegradation, and contaminant loss at the sediment-water interface. The model estimates the time required for sediment concentrations to decrease to levels considered acceptable (i.e., concentrations below chemical-specific sediment quality objectives). The model also allowed an evaluation of changes in areal extent of sediment problem areas given estimated levels of source control over varying timeframes. A 10-year timeframe for natural recovery was recommended in the feasibility study based on precedents in environmental legislation; the balance of remediation-related impacts relative to continued exposure, monitoring, and practicality; and requirements in the 1989 PSWQA plan (PSWQA 1988) to consider natural recovery, cost, and feasibility in developing sediment remedial guidelines.

Given sufficient levels of source control, natural recovery was predicted in the feasibility study (Tetra Tech 1988a) to reduce the volume of sediments requiring remediation at the CB/NT site by up to 40 percent. Natural recovery was shown to be effective within a 10-year period following source control in areas that were marginally contaminated above sediment quality objectives. The advantages of incorporating natural recovery as an element of the remedy appeared to outweigh the disadvantages in such circumstances. For example, concern about the integrity of the natural cap is offset by the relatively low impact of potential exposure to underlying sediments in marginally contaminated areas. Natural recovery was therefore considered an important mitigating factor in the feasibility study.

8. DESCRIPTION OF ALTERNATIVES

The purpose of the CB/NT feasibility study was to develop and evaluate the most appropriate remedial strategies for correcting the human health and environmental impacts associated with contaminated sediments in the CB/NT problem areas. The feasibility study described cleanup objectives for the site and then presented a range of alternatives that offered viable means of achieving those objectives.

Ten candidate alternatives were identified in the CB/NT feasibility study:

1. No-action
2. Institutional controls
3. *In situ* capping
4. Removal/confined aquatic disposal
5. Removal/nearshore disposal
6. Removal/upland disposal
7. Removal/solidification/upland disposal
8. Removal/incineration/upland disposal
9. Removal/solvent extraction/upland disposal
10. Removal/land treatment.

Although the names of the alternatives reflect characteristics of the specific sediment remedial action that they include, all candidate alternatives except the no-action alternative also include one or more of the following major elements:

- **Site use restrictions**—Protect human health by limiting access to edible resources prior to and during implementation of source and sediment remedial activities.
- **Source controls**—Implemented to prevent recontamination of sediments. Source control may be enhanced relative to existing programs, and consequently accelerate sediment remediation schedules by providing additional resources to focus activities on sources that contribute contaminants to sediments.
- **Natural recovery**—Included as an optional (and preferred) remediation strategy for marginally contaminated sediments that are predicted to achieve acceptable sediment quality through burial and mixing with naturally accumulating clean sediments.
- **Sediment remedial action**—Address sediments containing contamination that is expected to persist for unacceptable periods of time through confinement and treatment options.
- **Source and sediment monitoring**—Refine cleanup volume estimates, characterize the effectiveness of source controls, and ensure that the remedy is effective.

The way in which major elements are included in each candidate alternative is summarized in Table 6.

The following section summarizes the project cleanup objective. The next section describes the general characteristics of five major elements of the candidate alternatives and their interrelationships. This is followed by a description of the general characteristics of the 10 candidate

TABLE 6. MAJOR ELEMENTS OF THE 10 CANDIDATE ALTERNATIVES

	Element					
				Sediment Remedial Action		
Alternative	Use Restriction	Source Control	Natural Recovery	Confinement	Treatment	Monitoring
1. No Action	No	Existing programs[a]	Yes	No	No	No
2. Institutional Controls	Yes	Enhanced	Yes	No	No	Yes
3. *In Situ* Capping	Yes	Enhanced	Preferred[b]	Yes	No	Yes
4. Removal/Confined Aquatic Disposal	Yes	Enhanced	Preferred	Yes	No	Yes
5. Removal/ Nearshore Disposal	Yes	Enhanced	Preferred	Yes	No	Yes
6. Removal/ Upland Disposal	Yes	Enhanced	Preferred	Yes	No	Yes
7. Removal/ Solidification/ Upland Disposal	Yes	Enhanced	Preferred	Yes	Yes	Yes
8. Removal/ Incineration/ Upland Disposal	Yes	Enhanced	Preferred	Yes	Yes	Yes
9. Removal/Solvent Extraction/ Upland Disposal	Yes	Enhanced	Preferred	Yes	Yes	Yes
10. Removal/ Land Treatment	Yes	Enhanced	Preferred	Yes	Yes	Yes

[a] No program enhancement or focus under federal Superfund.

[b] Presented as element of preferred alternative in CB/NT feasibility study (Tetra Tech 1988a).

alternatives and the sediment remedial action that distinguish them. A description of ARARs and other factors to be considered (TBCs) concludes the description of alternatives.

8.1 SEDIMENT CLEANUP OBJECTIVES AND EXTENT OF CONTAMINATION

The long-term sediment quality goal for Puget Sound, defined by PSWQA (1988) as the absence of acute or chronic adverse effects on biological resources or significant human health risk, was translated into a set of sediment quality objectives for the CB/NT site. The sediment quality objectives were defined in discrete, measurable terms relative to specific human health risk assessments and environmental effects tests and associated interpretive guidelines. As such, sediment quality objectives form the basis for both source control and sediment remedial actions. The process for developing these sediment quality objectives is described in greater detail in Sections 7.1.4 and 7.2.4 of this Record of Decision, in the feasibility study (Tetra Tech 1988a), and in the development of sediment cleanup goals (PTI 1988).

Sediment quality objectives were also translated into sediment remedial action levels and source control levels. Sediment remedial action levels incorporate technical feasibility and cost considerations by incorporating mitigating factors such as natural recovery. The sediment remedial action level differentiates areas that exceed the sediment quality objective, but are predicted to recover naturally, from those that are more significantly contaminated and therefore require active remediation to achieve the sediment quality objectives. If natural recovery is predicted to be effective in achieving the cleanup objective in a reasonable timeframe (10 years), then no sediment remediation would be required.

For sources, the relationship to the sediment quality objectives identified for the CB/NT site is less direct. Ecology's source control program will consider applicable state sediment standards (currently under development) which are also based on the long-term sediment quality goal for Puget Sound. Ecology's proposed source control requirements incorporate technical feasibility and cost considerations by requiring utilization of AKARTs and compliance with appropriate ARARs. Sediment quality standards (or interim values) will not explicitly be used to derive effluent limits, but they will be considered in the selection of appropriate treatment technologies.

In the feasibility study, sediment remedial alternatives were developed for two options: 1) active remediation of all sediments failing sediment quality objectives, and 2) active remediation of sediments failing remedial action levels and natural recovery of marginally contaminated areas. In both cases, the long-term overall project cleanup objective was to attain sediment quality objectives. Therefore, the extent of contamination in each problem area was estimated according to chemical exceedance of one or more of the sediment quality objectives.

Problem chemicals that exhibited the greatest elevation over effects indices (AET) over the greatest area were selected as indicator chemicals in the CB/NT feasibility study, and used to support the development and evaluation of remedial alternatives. The spatial distribution of indicator chemicals was used to estimate the volume of sediments exceeding the sediment quality objectives in the feasibility study and to determine the effect of source control and natural recovery.

8.2 KEY ELEMENTS OF CANDIDATE ALTERNATIVES

Candidate alternatives identified in the feasibility study were represented by specific combinations of source- and sediment-related activities that in most cases (i.e., excluding the no-action and institutional controls alternatives) were structured to achieve the project objective of acceptable sediment quality within a reasonable time. According to the feasibility study, this project objective was to be achieved by implementing the major elements of each candidate alternative in an interdependent, integrated fashion. Sediment remedial action was proposed after major sources were identified and controlled. Natural recovery of sediments was defined as an acceptable option if it was predicted to occur for all or part of a problem area within a reasonable time (i.e., within 10 years following the identification and control of major sources of contamination). Monitoring was described as most important in the early stages of remedial action to ensure that sources would be adequately controlled and to provide a baseline for future assessment of adequacy of source control, rate of sediment recovery, and permanence of sediment remedial action.

8.2.1 Site Use Restrictions

Site use restrictions consist mainly of public warnings to reduce potential exposure to site contamination, particularly ingestion of contaminated seafood. Local health advisories are an integral part of the overall remedy because the ultimate cleanup objective was projected to be achieved over a 10-15 year period.

8.2.2 Source Control

Source control activities specified for the 10 candidate alternatives are characterized as either *existing* programs or *enhanced* programs (Table 6). The designation *existing* programs indicates that no additional effort would be expended to accelerate implementation of these programs and subsequent sediment remedial action. *Enhanced* source control requires that additional resources be focused on identification of unknown sources, characterization of suspected sources, and control of known sources that are contributing contaminants to the high priority problem areas at the CB/NT site. *Existing* source control programs were focused on by the Commencement Bay UBAT following the remedial investigation. Source control efforts have recently been enhanced through a cooperative agreement between EPA and Ecology awarded 30 June 1989 (see Section 3.4). This expanded effort will ensure that sediment remedial action takes place in a timely fashion. Source control and remedial activities related to sources in Commencement Bay are broad-ranging in scope and status of action. For many sources (e.g., shipyards), the implementation of best management practices is the main form of remedial action. There is a variety of more traditional types of remedial action that have been or will be implemented to mitigate contamination at sources. These range from preliminary actions that address the most severe site contamination (e.g., site stabilization, expedited response action) to more comprehensive remedial measures (i.e., remedial design and remedial action). In general, appropriate source control actions have been identified on the basis of site-specific studies. Many of the ongoing source-related activities were initiated based on the results of the CB/NT remedial investigation (Tetra Tech 1985) and focus on problem areas and problem chemicals identified in the CB/NT remedial investigation. Source control actions for additional significant sources that are identified during the ongoing studies will be integrated into the overall remedy for each problem area.

In general, Ecology will use consent orders, consent decrees, and administrative orders to drive source-related activities. Orders and decrees, which can be issued at any time during the remedial process, may specify either a single action or numerous actions. One or more permits are also typically required to implement source controls. Many of the major sources in the CB/NT area are subject to NPDES or RCRA permits. In addition, special permits may be required for certain remedial activities (e.g., air quality permits for groundwater stripping of volatile organic compounds). A summary of major permits or regulatory mechanisms relevant to source control actions is presented in Section 3.

A summary of the status of source identification, characterization, and control efforts in the eight high priority areas addressed in this Record of Decision is provided in Table 7. Details of the process for determining the acceptability of source control efforts are described in Section 10. Implementation schedules for this Record of Decision are summarized in Appendix C.

TABLE 7. STATUS OF SOURCE CONTROL ACTIVITIES IN COMMENCEMENT BAY NEARSHORE/TIDEFLATS PROBLEM AREAS

		Site Characterization		Site Remedial Action		
Site	Order/ Decree	Status[a]	Completion Date	Status[a]	Completion Date	NPDES Permit
Head of Hylebos Waterway						
Kaiser Aluminum & Chemical Co.	1/90	U	9/89	P	90	11/89[b]
Pennwalt Chemical Corp.	6/87, 3/89	U	10/89	U	91	8/90[b]
General Metals, Inc.	8/87	C	7/89	U	12/89	12/89
3009 Taylor Way Log Sorting Yard	6/87, 90	U	6/90	P	91	
Wasser Winters Log Sorting Yard	3/87	U	89	P	12/90	
Louisiana-Pacific Log Sorting Yard	6/87	C	6/89	P	10/90	
Cascade Timber Log Sorting Yard #2	2/90	P	90	P	93	
B&L Landfill	2/89, 8/90	U	6/90	P		
Tacoma Boatbuilding Co.	7/89	C	1/87	O		12/89
Storm drains						91
Additional source identification		O				
Mouth of Hylebos Waterway						
Occidental Chemical	11/88	U	9/89	P	91	3/90[b]
Storm drains						91
Additional source identification		O				
Sitcum Waterway						
Terminal 7				O		
Storm Drain SI-172		C	7/89	U	4/90	
Other storm drains						91
Additional source identification		O				
St. Paul Waterway						
Simpson Tacoma Kraft	12/85, 12/87			C	9/88	12/89[b]
Storm drains						91
Additional source identification		O				

TABLE 7. Continued

Site	Order/ Decree	Site Characterization Status[a]	Site Characterization Completion Date	Site Remedial Action Status[a]	Site Remedial Action Completion Date	NPDES Permit
Middle Waterway						
Cooks Marine Specialties				O		12/89
Marine Industries Northwest				O		12/89
Storm drains						91
Additional source identification		O				
Head of City Waterway						
American Plating	11/86, 9/87, 10/89		5/89	P	90	
Martinac Shipbuilding				O		1/90
Storm Drains CS-237, CN-237, CI-230		C	4/90	U		
Tacoma Spur site		O				
Other storm drains						91
Additional source identification		O				
Wheeler-Osgood Waterway						
Storm Drain CW-254		C	4/90	U		
Other storm drains					91	
Additional source identification		O				
Mouth of City Waterway						
D Street Petroleum	11/88, 91	U	12/89	P	92	
Storm drains					91	
Additional source identification		O				

[a] U - Underway
P - Planned
C - Completed with long-term monitoring required
O - Ongoing element of overall source control effort.

[b] NPDES permit renewal date.

8.2.3 Natural Recovery

In the CB/NT feasibility study, the advantages and disadvantages of including natural recovery were evaluated for all of the alternatives that include sediment remedial action. In the CB/NT feasibility study, two options were analyzed for each candidate remedial alternative that considered sediment remedial action: 1) remedial action alone achieves the sediment quality objective, and 2) natural recovery is considered acceptable for all portions of the problem area that are predicted to reach the sediment quality objective within 10 years, and sediments that are not predicted to achieve this objective are subject to remedial action. Natural recovery of some or all of a given problem area may occur through chemical degradation, diffusive losses of contaminants across the sediment-water interface, and burial and mixing of contaminated surface sediments with recently deposited, clean sediments.

Natural recovery is expected to be effective in marginally contaminated portions of each problem area, but it is not intended to address severe levels of contamination. To determine the cleanup level, a recovery factor was developed using the mathematical model SEDCAM (described in Section 7.3.2). Recovery factors represent the ratio of the cleanup level to the sediment quality objectives for different chemicals. Recovery factors developed in the CB/NT feasibility study ranged from 1.2 to 4.6 for different indicator chemicals in the different problem areas. That is, in some areas sediments contaminated at up to 4.6 times the sediment quality objective were predicted to recover within 10 years following source control. The value of a recovery factor is a function of the source loading rate, sedimentation rate, depth of the surface sediment mixed layer, and chemical degradation. Recovery factors identified in the feasibility study were based on limited data, and will be further developed as a result of continued source investigation and monitoring, additional sediment sampling conducted during remedial design, and emerging information on other processes (e.g., sediment resuspension, new degradation rate data) that may alter recovery rates and the feasibility study (Tetra Tech 1988a).

8.2.4 Sediment Remedial Action

Sediment remedial action is directed at sediments that exceed the sediment quality objective or are predicted to exceed the sediment quality objective within 10 years (if the natural recovery option is included in the overall site remedy). Sediment remedial action falls into the general categories of confinement and treatment (Table 6). Confinement remedies isolate contaminated sediments but do not decrease toxicity, mobility, or volume. Treatment alternatives include technologies that destroy or entrap problem chemicals, effectively reducing toxicity, mobility, or volume. Details of the sediment remedial action that characterizes the 10 candidate alternatives are described in Section 8.3 and the feasibility study (Tetra Tech 1988a).

8.2.5 Monitoring

Source and sediment monitoring are critical for determining the success of individual remedial actions and ensuring that all necessary remedial actions have been undertaken in a problem area. The overall objective of source monitoring is to document the level of source control achieved and the attainment of environmental quality goals. Sediment monitoring will include a combination of chemical and optional biological tests as summarized in Section 8.1. Further detail regarding sampling design and monitoring is provided in the CB/NT feasibility study (Tetra Tech 1988a) and in the integrated action plan (PTI 1988). Sampling and test evaluation protocols for environmental effects, as well as the AET database, are to remain consistent with any adjustments adopted by the Puget Sound Estuary Program. New tests will only be considered if they are adopted as replacements for one of the three biological indicators described in this Record of Decision. When both biological and chemical test results are available for a particular sediment sampling station, the results of a particular biological test will outweigh the AET predictions of that biological effect based on chemistry.

Source monitoring data are collected as part of the source control programs discussed above in Section 8.2.2. During sediment remedial design, monitoring of poorly characterized sources may also be necessary to refine estimates of the importance of source control at those facilities. This monitoring may be coordinated with reconnaissance surveys designed to assess the relative importance of ongoing and historical sources of contamination.

Monitoring of sediment contamination is conducted before and after sediment remediation and serves the following purposes:

- Baseline sediment sampling during remedial design and again during remedial action establishes a recent basis for assessing the success of the remedial alternative
- Monitoring is used to confirm predicted recovery of problem sediments within a reasonable time period (10 years) when sediment remedial action is not required for all or a portion of the cleanup volume
- Post-remedial action monitoring enables assessment of the success of source control efforts and provides a record indicating that the sediment problem has been mitigated (e.g., successful operation of a disposal facility).

Baseline monitoring requirements are satisfied by sampling conducted during remedial design to refine the estimated cleanup volume and during sediment remedial action to serve as a baseline for evaluating natural recovery processes. Additional monitoring may be advisable depending on the time lapse before implementation of the sediment remedial alternative.

The recommended frequency of sediment monitoring depends on the documented success of source control. Annual sampling for sediment chemistry and biological effects is recommended for the first several years following implementation of sediment remedial action. If results confirm that sources have been adequately controlled, then the frequency can be decreased. For well controlled sources or in the absence of ongoing sources, sediment monitoring is used primarily to determine the success of sediment remedial action. When only partial source control is possible, more frequent sediment monitoring may be necessary to determine the need for subsequent sediment remedial action.

8.3 CANDIDATE ALTERNATIVES

Each candidate alternative represents a combination of the major elements described above. Implicit in each of the identified alternatives (except no-action) is the aggressive pursuit of source control measures under all existing environmental authorities to reduce contaminant inputs to sediments to the maximum extent possible using AKARTs. The level of source control was considered in evaluating alternatives to assess long-term effectiveness and the potential for natural recovery. Details of these candidate alternatives are presented in the feasibility study (Tetra Tech 1988a).

8.3.1 Alternative 1: No-Action

The no-action alternative supplies a baseline against which other sediment remedial alternatives can be compared. Under the no-action alternative the site would be left largely unchanged, with no remediation of sediment contamination, although some degree of natural recovery may be evident in areas impacted by historical sources. This alternative does nothing to mitigate the public health and environmental risks associated with the site, but its evaluation is required by the NCP. Absence of any additional resources for source control through an EPA/Ecology cooperative agreement under Superfund is an implicit element of this alternative. Potential impacts of the no-action alternative include the following:

- Continued potential for human health effects associated with consumption of contaminated fish and shellfish
- Continued high incidence of fish disease (e.g., liver lesions)
- Continued bioaccumulation of problem chemicals in the aquatic food chain
- Continued depressions of the benthic communities (reducing the value of contaminated areas as habitat for fishery resources)
- Continued acute and chronic toxicity for marine organisms associated with sediments.

8.3.2 Alternative 2: Institutional Controls

Institutional controls include access restrictions, limitations on recreational use of nearshore areas, issuance of public health advisories, monitoring to evaluate changes in sediment characteristics, and most important, enhanced regulatory control of contaminant sources specifically oriented toward mitigation of sediment contamination. Limitations on access and recreation (e.g., fishing, diving) reduce human exposure and risk to public health, but do nothing to mitigate the existing environmental impact mentioned under the no-action alternative. Some degree of long-term mitigation is expected as a result of reduction in source loadings. Sediment monitoring is included in this alternative to permit identification of contaminant migration patterns and assess sediment recovery associated with source control. Monitoring would be designed to enable assessment of changes in risks to public health and the environment before impacts are realized.

8.3.3 Alternative 3: *In Situ* Capping

In situ capping involves containment and isolation of contaminated sediments through placement of clean material on top of existing substrate. The capping material may be clean, dredged material or fill (e.g., sand). In addition, it may be feasible to include additives (e.g., bentonite) to reduce the hydraulic permeability of the cap or sorbents to inhibit contaminant migration. Both mechanical and hydraulic dredging equipment can be used for *in situ* capping operations. Cohesive, mechanically dredged material would be placed by using a split-hulled barge. Hydraulically dredged material would be placed by using a downpipe and diffuser. Depending on site topography, diking may be necessary along a margin of the capped sediments to provide lateral cap support.

For the purposes of evaluating the capping alternative and estimating costs, it was assumed that clean, dredged material from the Puyallup River would be used to construct the cap. Although *in situ* capping has been successfully conducted with hydraulic dredging equipment, for costing purposes it was assumed that the capping material would be dredged using a clamshell dredge to maintain cohesiveness, transported to the problem areas, and deposited hydraulically to create a cap with a minimum thickness of 3 feet. Evaluation during design may dictate placement of additional capping material to prevent failure due to erosion or diffusion of mobile contaminants.

8.3.4 Alternative 4: Removal/Confined Aquatic Disposal

Several confined aquatic disposal options were described in the CB/NT feasibility study. These options include waterway confined aquatic disposal, shallow-water confined aquatic disposal, open-water confined aquatic disposal, and open-water mounded confined aquatic disposal. These options differ from one another based largely on location, depth, and physical characteristics of the disposal site. Design features of an in-waterway confined aquatic disposal site are illustrated in Figure 14. Mechanical dredging followed by split-hulled barge placement techniques can be used to implement this alternative. The thickness of the cap required for confined aquatic disposal options ranges from 3 to 6 feet, depending on wave and tidal energies and water depth at the disposal site. Onsite confined aquatic disposal could be implemented within a designated shipping area. This approach would entail dredging an area well below the zone of contamination,

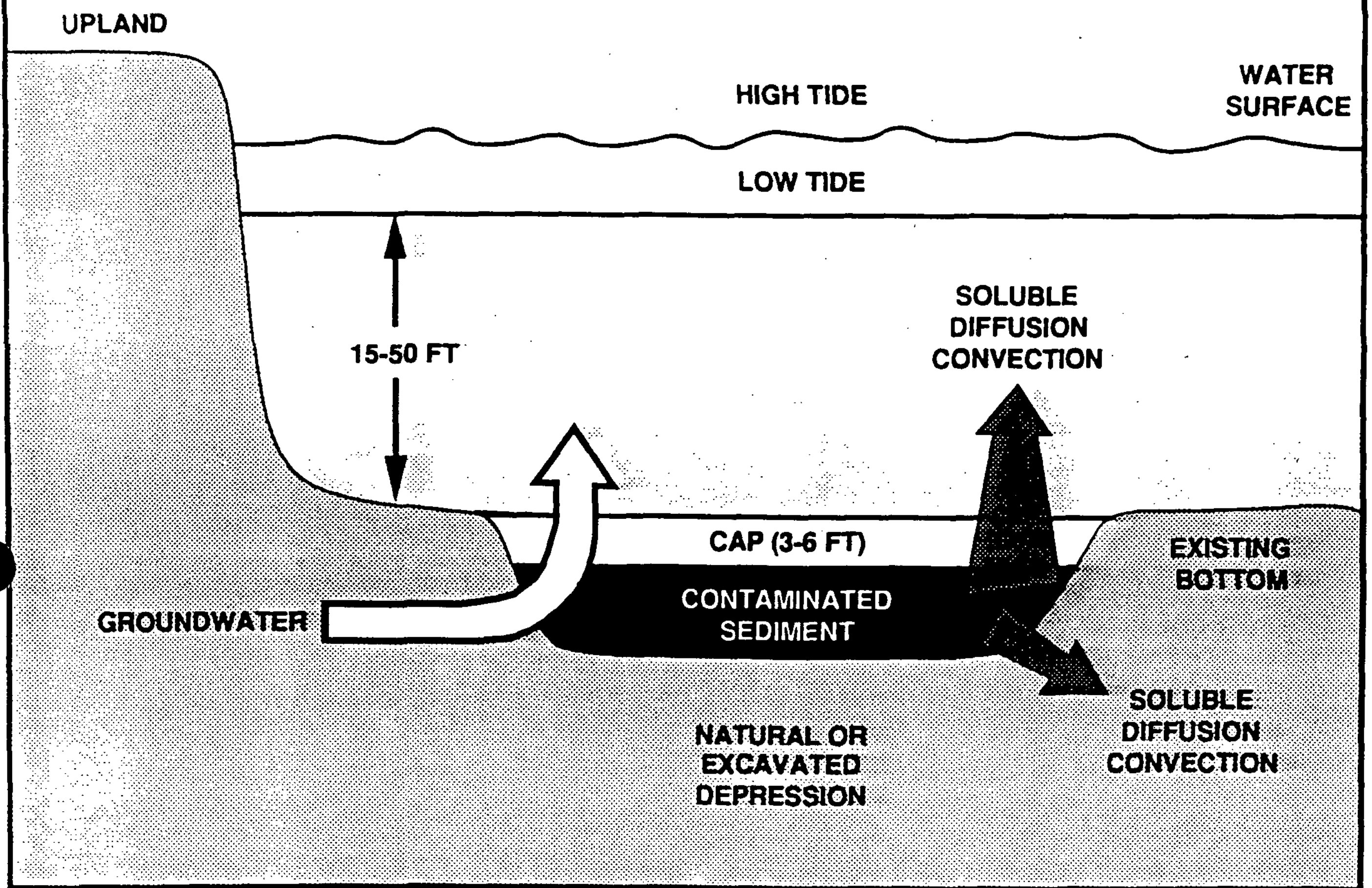


Figure 14. In-waterway confined aquatic disposal of contaminated dredged material

depositing contaminated dredged material in the excavated pit, and capping it with a thick layer of clean, dredged material if future navigational dredging were anticipated.

Use of an offsite open-water confined aquatic disposal site was assumed in the CB/NT feasibility study for costing purposes because a deep-water site of sufficient capacity for a large volume of material had been identified as potentially viable. A clamshell dredge would be used to maintain nearly *in situ* densities. Also, by minimizing water entrainment, a clamshell dredge would result in easier transport and fewer or less severe water quality impacts during dredging and disposal operations. Dredged materials would be transported to the disposal site and placed directly using a split-hulled barge to limit bulking and water column impacts. Capping materials would subsequently be placed in the disposal site using a submerged diffuser system to minimize water column turbidity and facilitate more accurate placement of materials. Use of the diffuser system would eliminate upper water column impacts by radially dispersing the material parallel to and just above the bottom at low velocity (Phillips et al. 1985).

8.3.5 Alternative 5: Removal/Nearshore Disposal

Dredging followed by confined disposal in the nearshore environment is another alternative for sediment remediation at the CB/NT site. Generally, nearshore sites must be diked before they can receive dredged material. There are essentially no limitations in the selection of dredging and transport equipment, although hydraulic dredging followed by pipeline transport to the disposal facility is considered optimal (Phillips et al. 1985). All variations considered for the removal/nearshore disposal option use industry standard equipment and methods that are generally available. Hydraulic dredging confines dredged material to a pipeline during transport, thereby minimizing exposure potential and handling requirements. Systems for management and treatment of dredge water can be readily incorporated into the facility design. The distances between several of the problem areas and a tentatively identified Blair Waterway nearshore disposal site are great. Material dredging with a clamshell system would be used for implementing this alternative in problem areas more than 2 miles from the disposal site. For problem areas within 2 miles, a hydraulic dredging system would be possible. Logistical problems may be encountered, however, in areas with heavy marine traffic.

A schematic drawing depicting general features of a nearshore confined disposal facility is presented in Figure 15. To accommodate a dredge water control system using chemical flocculation, the secondary settling basin would resemble that illustrated in Figure 16. Other assumed design features include fill depth of 30 feet and a minimum cap thickness of 3 feet. Additional capping material may be required to facilitate subsequent construction over the confinement facility. The facility was assumed to be unlined.

For the purpose of evaluating this alternative in the feasibility study, it was assumed that the nearshore disposal facility in Blair Waterway would be used. For the Record of Decision, this alternative was evaluated and costs were developed assuming disposal was incorporated into planned construction projects.

8.3.6 Alternative 6: Removal/Upland Disposal

Dredging followed by upland disposal would involve the transfer of dredged material to a land-based confinement facility and would be implemented following source control. Sediment could be dredged either mechanically or hydraulically and transferred to the disposal site by truck, rail, or pipeline. As in the case of nearshore disposal, the alternative can be implemented using standard dredging and transport equipment that is generally used for similar operations. Provisions would be required for the management of dredge water and leachate generated during the dewatering process. Disposal site design features would include a liner and cap. The liner system would include an underdrainage system for dewatering the fill material and for controlling leachate over the long term. The underdrainage system would be designed to operate as either a passive collection system or a vacuum-assisted dewatering system.

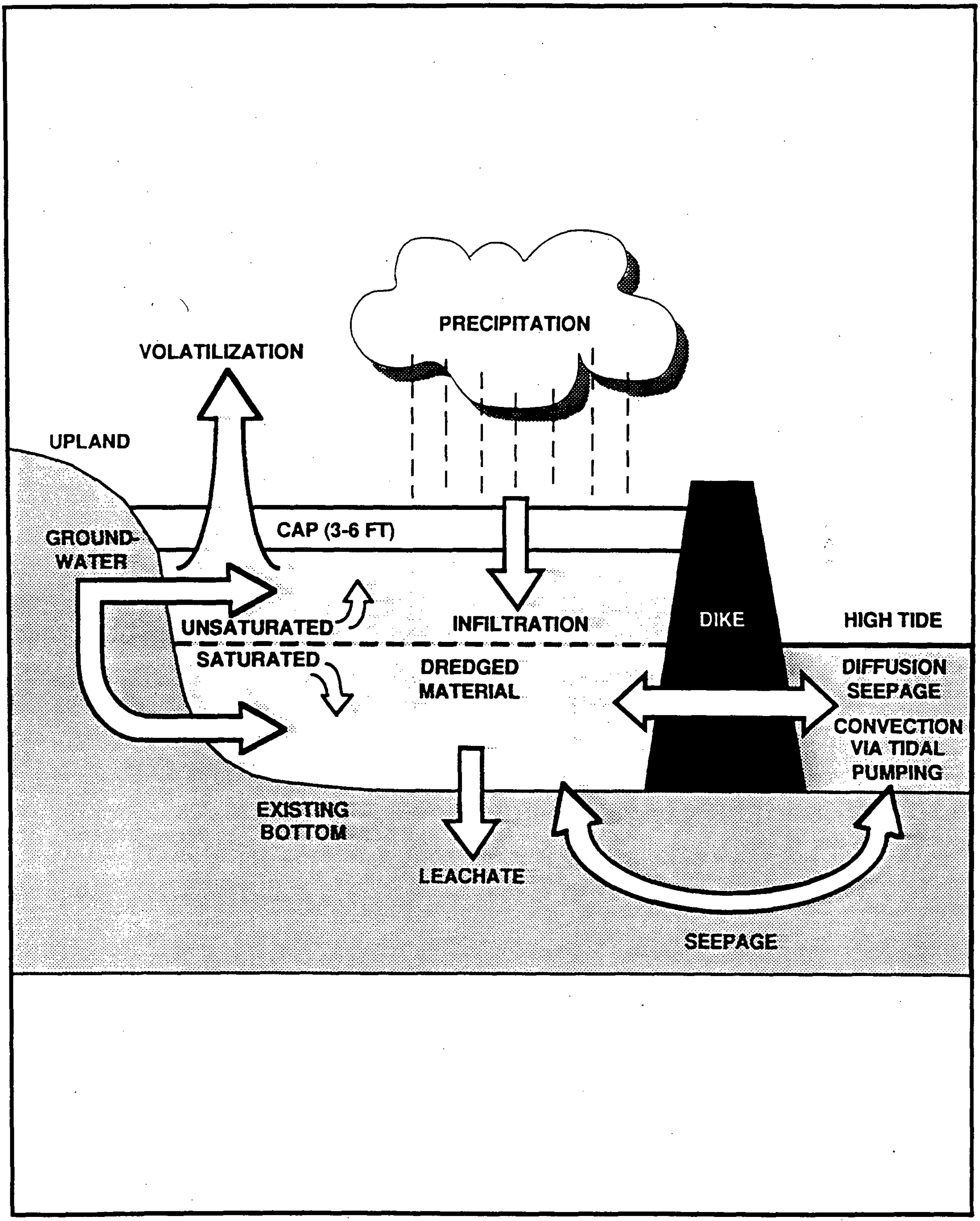
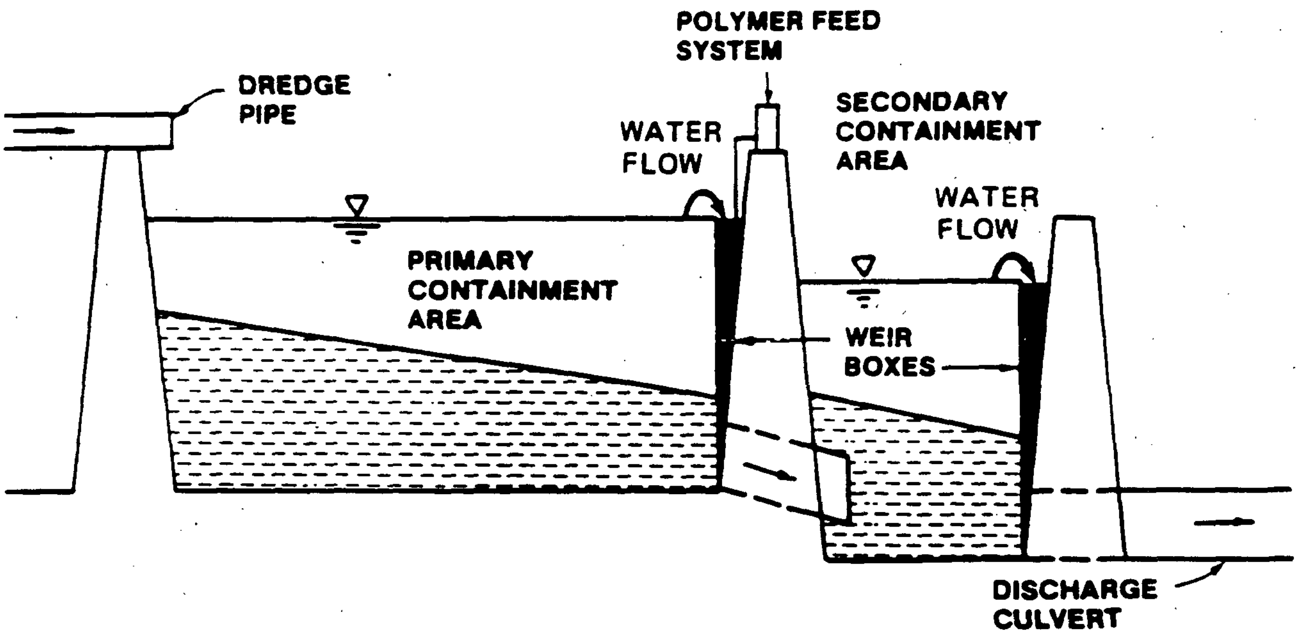


Figure 15. Confined nearshore disposal of contaminated dredged material



Reference: Phillips et al. (1985).

Figure 16. Dredge water chemical clarification facility

A schematic drawing of an upland confinement facility is presented in Figure 17. Dredge water clarification (e.g., using the secondary settling basin and chemical clarification design shown in Figure 16) would be an essential feature of the facility. It was assumed that the disposal facility would be constructed to contain contaminated dredged material to a depth of 15 feet. A dual synthetic liner and passive underdrainage system would be included to permit removal of percolating dredge water and allow for long-term leachate collection. Dredged material would settle, and ponded dredge water would be removed. Passive collection of percolating water would continue until the fill consolidates to an extent that allows capping operations to commence. The upland landfill would be lined with a synthetic liner material or clay and would have an underdrainage system. The cap would be 2 feet thick and would be composed of clay.

For the purpose of evaluating this alternative, it was assumed that an upland disposal site would be developed within 3 miles of the problem area to meet the CERCLA preference to avoid the offsite transport and disposal of untreated waste. Compared to the *in situ* capping and nearshore disposal alternatives, additional time would be required prior to implementation to allow for siting and development of an upland disposal facility. Dredging would be conducted using a pipeline cutterhead dredge, and material would be hydraulically transported to the disposal site.

8.3.7 Alternative 7: Removal/Solidification/Upland Disposal

Solidification, in conjunction with clamshell dredging and upland disposal, is another option for treatment of contaminated dredged material. Treatment by solidification could be conducted at either nearshore or upland disposal sites. Either hydraulic or mechanical dredging equipment could be used to remove the contaminated sediment. In the former case, sedimentation to remove most of the dredge water would be required prior to blending in the solidification agents. As discussed in the CB/NT feasibility study, several solidification agents and implementation scenarios are feasible for this treatment option, although none has been field tested with marine sediments.

Design features for the disposal facility would depend on the hazard level of the solidified sediment. In developing this alternative, it was assumed that the treated material would not be a RCRA hazardous waste and that the confinement facility would be designed to satisfy minimum functional standards for landfills in accordance with state regulations (WAC 173-304). The liner would be composed of clay or be a synthetic liner, which would meet the maximum permeability standard of 1×10^{-7} cm/second. An underdrainage system atop the liner would remove dredge water. The facility would accommodate a 15-foot fill depth and be capped with 2 feet of clay to meet a permeability standard of 1×10^{-6} cm/second.

For the purpose of developing cost estimates, it was assumed that a cement/pozzolanic process would be used. For the evaluation of this alternative, contaminated sediments were assumed to be mechanically dredged and transported to the upland site. Dredged material would be staged in hoppers and fed by a screw conveyor system for solidification. Mixing would be completed in a treatment facility with in-line mixing of solidification agents. Discharge would be either directly to the confinement facility or to a truck for transport to the facility. Curing times for the process may be extended as a result of the salt content of the dredged material.

8.3.8 Alternative 8: Removal/Incineration/Upland Disposal

Although incineration permanently eliminates organic contamination in sediments, this alternative has limited application in the CB/NT site for two reasons. First, most problem areas are characterized by significant metals contamination, which is not mitigated by incineration. Second, marine sediments are characterized by very low Btu content, making incineration extremely energy-intensive and less cost-effective. As for the other alternatives, implementation of source control measures was assumed.

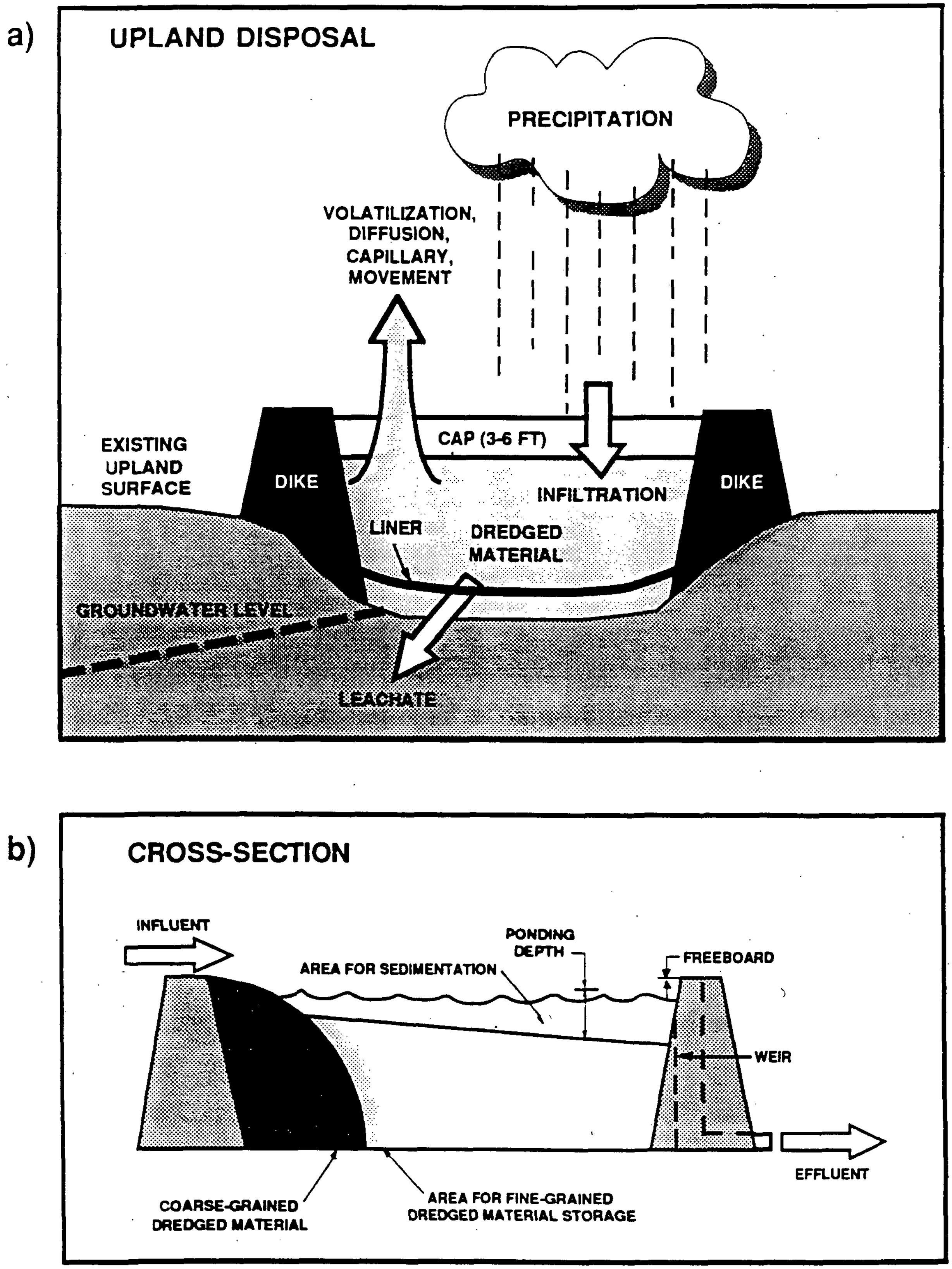


Figure 17. Confined upland disposal (a) and components of a typical diked upland disposal site (b)

For this alternative, sediments were assumed to be mechanically dredged, using a watertight clamshell bucket to minimize water content of the dredged material, minimize water column partitioning of contaminants, and maintain *in situ* sediment densities. The dredged material would be transported to shore by barge and then to an upland site for incineration. It is possible that an incinerator could be located adjacent to the problem area and transport by truck could be avoided. Analysis of the incinerated residue may reveal that the material no longer requires special handling and confinement. Open-water disposal may be a feasible option for disposal of incinerated contaminated dredged material, but for this alternative, disposal in a minimum security landfill was assumed for evaluation.

8.3.9 Alternative 9: Removal/Solvent Extraction/Upland Disposal

For sediments containing primarily organic contaminants, solvent extraction followed by incineration of the organic concentrate would be a feasible alternative. This approach to sediment remediation would result in permanent removal and destruction of organic compounds. It was assumed that contaminated sediments would be dredged using a clamshell, transported via barge, and offloaded using a clamshell to an onshore treatment facility. The contaminated dredged material would be treated, dried, and transported to an upland disposal facility. Because the process effectively dewaters the solids, stabilization was considered unnecessary.

For the purpose of evaluating this alternative, use of the BEST® technology marketed by Resources Conservation Company (Bellevue, Washington) was assumed. Effluents from the process would include wastewater and treated solids, and a concentrated organic waste that might require additional treatment. Solids retain a low residual concentration of extracting solvent, and depending on metals content, may be returned to the removal site for unconfined disposal, placed in a PSDDA open-water disposal site, or landfilled in a secure facility. The latter was assumed for estimating costs. The extracting solvent, typically triethylamine, is not a listed hazardous waste constituent, which simplifies waste solids and wastewater disposal.

8.3.10 Alternative 10: Removal/Land Treatment

For sediments contaminated with biodegradable organic compounds, a land treatment option was considered. Land treatment involves the incorporation of waste into the surface zone of soil, followed by management of the treatment area to optimize degradation by natural soil microorganisms. Chemical and physical characteristics of the waste need to be evaluated to determine the amount that can safely be loaded onto the soil without adversely impacting groundwater. Soils possess substantial cation exchange capacity, which can effectively immobilize metals. Therefore, wastes containing metals can be land-treated, but careful consideration of the assimilative capacity of the soil for metals is essential.

For evaluating this alternative, it was assumed that source control would be implemented and that sediments would be removed using a clamshell dredge to minimize water content of the dredged material. After transport by barge and truck to the land treatment facility, the sediment material would be distributed and tilled into the upper 15-30 cm of soil. The land treatment facility design would prevent stormwater run-on and allow collection and management of runoff. Lysimeters and monitoring wells would be installed and periodically sampled to aid in the detection of subsurface contaminant migration.

8.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Remedial actions implemented under CERCLA must meet legally applicable or relevant and appropriate requirements (ARARs). ARARs include promulgated environmental requirements, criteria, standards, and other limitations. Other factors to be considered (TBCs) in remedy selection may include nonpromulgated standards, criteria, advisories, and guidance, but are not evaluated pursuant to the formal process required for ARARs. ARARs of federal, state, and tribal governments must be complied with during CERCLA response actions. Local ordinances with promulgated criteria or standards are not considered ARARs but may represent important TBCs. Major chemical-specific, location-specific, and action-specific ARARs and TBCs are presented in Tables 8, 9, and 10.

TABLE 8. MAJOR CHEMICAL-SPECIFIC ARARs FOR REMEDIAL ALTERNATIVES

Media	Citation	Requirement	Prerequisites for Applicability
Surface Water			
ARARs[a]			
Clean Water Act	33 U.S.C. Section 1251 Clean Water Act Section 301(b)	Direct discharges must meet technology-based standards	All direct discharges; applies to sources only
	33 U.S.C. Section 1251 40 CFR 125.120-125.124 40 CFR 227.22 Clean Water Act Section 403	Establishes limiting permissible concentrations for discharge into marine waters	Discharges to marine waters; applies to sources and sediment
	33 U.S.C. Section 1251 40 CFR 131 (U.S. EPA 1986)	Ambient water quality criteria for protecting aquatic organisms and human health	Fresh and marine waters; applies to sources and sediment
Washington Water Quality Standards	WAC 173-201	Water quality standards for surface waters	Surface waters of the state of Washington (conventional water quality parameters only); applies to sources and sediment
Puyallup Tribe Water Quality Program	Puyallup Tribal Council Resolution No. 151288C	Interim tribal water quality standards adopting Washington water quality standards	Surface waters of the state of Washington (conventional water quality parameters only); applies to sources and sediment
Water Pollution Control Act and Water Resources Act	RCW 90.48 and RCW 90.54	Requires use of all known available and reasonable methods of treatment (AKARTs) for controlling discharges to surface water	All direct discharges; applies to sources only
TBCs[b]			
Puget Sound Water Quality Authority Management Plan	PSWQA Plan (1988) Elements P-6 and P-7	Effluent limits for toxicants and particulates	NPDES or state waste discharge permits; applies to sources only

TABLE 8. (Continued)

Media	Citation	Requirement	Prerequisites for Applicability
Critical Toxicity Values Advisories (reference doses, carcinogenic potency factors)	Integrated Risk Information System, EPA Office of Health and Environmental Assessment Health Effects Assessments, Health and Environmental Effects Documents, and health advisories from the EPA Office of Research and Development and Office of Water	Toxicology indices used for estimating health risks	For use in conducting risk assessments; applies to both sources and sediment
Groundwater			
ARARs			
Clean Water Act	33 U.S.C. Section 1251 40 CFR 131 (U.S. EPA 1986)	Ambient water quality criteria for protecting aquatic organisms and human health	Groundwater on the site; applies to both sources and sediment (different standards may apply to different aquifer zones)
Resource Conservation and Recovery Act (RCRA)	40 U.S.C. 6901 40 CFR 264.110-264.120, 265.110-265.120	Closure and post-closure performance standards	RCRA facility closure; applies to sources only
	40 CFR 264.90-264.101, 265.90-265.94	Groundwater protection standards [maximum contaminant levels (MCLs)] must be met	RCRA facility; applies to sediment (upland disposal)
Safe Drinking Water Act - National Primary Drinking Water Standards	42 U.S.C. Section 300f *et seq.* 40 CFR 141 40 CFR 143	MCLs for maximum allowable levels of contaminants in public drinking water	Groundwater used as public drinking water; applies to sediment (upland disposal)
		Secondary MCLs for aesthetic qualities of public drinking water	Groundwater used as public drinking water; applies to sediment (upland disposal)

TABLE 8. (Continued)

Media	Citation	Requirement	Prerequisites for Applicability
Water Pollution Control Act and Water Resources Act	RCW 90.48 and RCW 90.54	Requires use of AKARTs for controlling discharges to groundwater	All direct discharges; applies to sources only
Air			
ARARs			
Clean Air Act	42 U.S.C. Section 7401 *et seq.* 40 CFR Part 50	Ambient air quality standards for chemicals and particulates	Air quality presently onsite or during treatment; applies to sources and sediment
TBCs			
Puget Sound Air Pollution Control Agency guidelines	Puget Sound Air Pollution Control Agency guidelines for acceptable ambient levels (AAL)	Sources must meet AAL guidelines	Action will produce air emissions; applies to sources and sediment
Sediment, Soils, and Solid Waste			
ARARs			
Toxic Substances Control Act	15 U.S.C. 2601 *et seq.* 40 CFR 761	Soil cleanup level for PCBs	PCB contaminated soils; applies to sources only (soils)
RCRA	42 U.S.C. 6901 40 CFR 261.24	EP toxicity test for contaminant leaching triggers handling and disposal requirements	Contaminated soils and sediments requiring land-based disposal
TBCs			
Puget Sound Dredged Disposal Analysis (PSDDA)	PSDDA (1988)	Chemical and biological criteria for dredged material disposal in Puget Sound	Disposal of dredged material suitable for open water, unconfined sites in Puget Sound; applies to sediment only

TABLE 8. (Continued)

Media	Citation	Requirement	Prerequisites for Applicability
Puget Sound Water Quality Management Plan (PSWQA 1988)	PSWQA Plan (1988) Element P-2	Sediment quality standards for contaminated sediments	Actions involving sediments having adverse biological effects or human health risk; applies to sediment
	PSWQA Plan (1988) Element P-3	Criteria for sediment impact zones and dilution zones	Wastewater discharges with dilution zones; applies to sources and sediment
	PSWQA Plan (1988) Element S-4	Regulations for disposal of dredged material exceeding Element P-2 standards	Dredged material requiring confined disposal; applies to sediment only
	PSWQA Plan (1988) Element S-7	Guidelines for sediment cleanup decisions	Applies to sediment exceeding Element P-2 standards
Biological Resources			
TBCs			
Food and Drug Administration	49 CFR 10372-10442	Maximum concentrations of contaminants in fish tissue	Interstate commerce of fish; applies to sources and sediment

[a] Applicable or relevant and appropriate requirements.

[b] Other factors to be considered.

TABLE 9. MAJOR LOCATION-SPECIFIC ARARs FOR REMEDIAL ALTERNATIVES

Location	Citation	Requirement	Prerequisites for Applicability
ARARs[a]			
Within 100-year floodplain	40 CFR 264.18(b)	Facility must be constructed, maintained, and operated to prevent washout	RCRA hazardous waste treatment, storage, and disposal; applies to sources and sediment
Within floodplain	Executive Order 11988 40 CFR 6 Appendix A	Action to avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values	Action will occur in lowlands and flat areas adjoining inland and coastal waters
Wetland	Executive Order 11990 40 CFR 6 Appendix A	Action to avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values	Action will destroy, modify, or develop wetlands; applies to sources and sediment
Oceans or waters of the United States	Clean Water Act Sections 404 and 401 40 CFR 125	Action to dispose of dredged and fill material requires a permit	Actions in oceans and waters of the United States; applies to sediment only
	Rivers and Harbors Appropriations Act Section 10	Actions which obstruct or alter a navigable waterway require a permit	Obstruction or alteration of a navigable waterway; applies to sediment only
Commencement Bay/ Puyallup River Watershed	Puyallup Tribe of Indians Settlement Act of 1989, PL-101-41, 103 STAT. 83 (21 June 1989)	Observe tribal environmental standards, and standards and requirements for cultural and religious preservation	Activities affecting environmental quality including fisheries, habitat, surface water, and groundwater; applies to sources and sediment
		Enhance fisheries resources	Actions which impact fisheries resources; applies to sediment only
Within state of Washington hazardous waste site	Model Toxics Control Act (Initiative 97), Chapter 2 (RCW), Laws of 1989	Imposes substantive cleanup standards	Source control actions taken at state hazardous waste sites

TABLE 9. (Continued)

Location	Citation	Requirement	Prerequisites for Applicability
Contaminated property	Hazardous Waste Management Act, Chapter 70.105 (WAC 173-303-420)	Presence of hazardous wastes	Source control actions at areas of contamination
Within 200 feet of shoreline	Shoreline Management Act, RCW 90.58	Substantive permit requirement	Actions impacting within 200 feet of shoreline
TBCs[b]			
Wetland	EPA Wetlands Action Plan, EPA Office of Water and Wetland Protection (January 1989)	No net loss of remaining wetlands base	Dredge and disposal of dredged material in wetlands

[a] Applicable or relevant and appropriate requirements.

[b] Other factors to be considered.

TABLE 10. MAJOR ACTION-SPECIFIC ARARs FOR REMEDIAL ALTERNATIVES

Action	Citation	Requirement	Prerequisites for Applicability
ARARs[a]			
Upland disposal (closure) of RCRA hazardous waste	40 CFR 264.11, 264.228, 264.258, 264.310 52 CFR 8712	Removal of all contaminated material	RCRA hazardous waste placed at site, or movement of waste from one area to another; applies to sources only
Upland disposal (containment) of RCRA hazardous waste	40 CFR 264.220, 264.221, 264.301, 264.303, 264.304, 264.310, 264.314, 268 Subpart D	Construction of new landfill onsite; design, maintenance, and operation requirements	RCRA hazardous waste placed in new landfill; applies to sources only
Upland disposal (postclosure)	40 CFR 246.1	Monitoring requirements	RCRA hazardous waste; applies to sources only
Upland disposal of solid waste or dangerous waste	WAC 173-304	Functional standards for solid waste handling	Material classified as solid waste; applies to sources and sediments
	WAC 173-303-070-110	Designation of material as dangerous waste	Material classified as dangerous waste; applies to sources and sediment
	WAC 173-303-141	Treatment, storage, and disposal of dangerous waste	Material classified as dangerous waste; applies to sources and sediment
	WAC 173-304-400; 420; 600; 610-670	Provisions for facility design, maintenance, and closure	Soils and sediments classified as dangerous waste requiring land-based disposal

TABLE 10. Continued

Action	Citation	Requirement	Prerequisites for Applicability
Dredging and disposal of dredged material open-water and near-shore	Clean Water Act Section 404 40 CFR 125	Dredging in waters of the United States requires a permit; action to dispose of dredged material requires a permit	Waters of the United States; applies to sediment only
	Clean Water Act Section 401 40 CFR 125	Dredging or aquatic disposal of dredged material requires state water quality certification	Applies to sediment only
	RCW 75-20.100 WAC 220-110	Requirement for a hydraulics permit	Interference with natural water flow of Washington state waters; applies to sediment only
Any action affecting the marine environment	Puyallup Tribe of Indians Settlement Act of 1989, PL-101-41, 103 STAT. 83 (21 June 1989)	Ensure substantial restoration and enhancement of fisheries resources	Activity must impact fisheries resources; applies to sources and sediments
	Puyallup Tribal Council Resolution No. 151288C	Interim tribal water quality standards adopting Washington water quality standards	Surface waters of the state of Washington (conventional water quality parameters only); applies to sources and sediment
Upland disposal (groundwater protection)	40 CFR 264.90-264.101, 265.90-265.94	Groundwater monitoring at RCRA disposal facilities and general protection requirements	RCRA hazardous waste; applies to sources and sediment
Incineration of dredged material	40 CFR 264.340-264.999, 265.270-265.299	Requirements for incineration of RCRA hazardous waste	RCRA hazardous waste; applies to sources and sediment
	Puget Sound Air Pollution Control Agency permit issuance	Requirements for incinerators to achieve local standards, new source requirements	Applies to sources and sediment
Direct discharge of treatment system effluent	40 CFR 125.123(b), 125.122, 125.123(d)(1), and 125.124	Requirements and criteria including compliance with federal water quality criteria and best available technology (BAT); NPDES permit requirements	Direct discharge to waters of the United States; applies to sources only

TABLE 10. Continued

Action	Citation	Requirement	Prerequisites for Applicability
Discharge to a publicly owned treatment works (POTWs)	40 CFR 403.5 40 CFR 264.71, 264.72	Requirements for discharges to POTWs	Discharge to Tacoma POTWs; applies to sources only
Land treatment	40 CFR 264.271, 264.273, 264.276, 264.278, 264.281, 264.282, 264.283	Design, monitoring, and treatment requirements	RCRA hazardous waste; applies to sources and sediment
Other treatment	42 U.S.C. 3004(d)(3), 3004(e)(3), 6924(d)(3), 6924(e)(3) 50 FR 40726 40 CFR 264 40 CFR 268.10-268.13	Proposed standards for treatment other than incineration and land treatment	RCRA hazardous waste; applies to sources and sediment
TBCs[b]			
Upland disposal of solid waste or dangerous waste	Tacoma-Pierce County Health Department Regulations for Sanitary Landfills (pending)	Disposal in an approved surface impoundment	Material must be classified as solid waste; applies to sources and sediment
Dredging and disposal of dredged material	Puget Sound Dredged Disposal Analysis (1988)	Dredged material must meet chemical and biological criteria for disposal in Puget Sound	Disposal of dredged material suitable for open-water, unconfined sites in Puget Sound; applies to sediment only
	EPA Wetlands Action Plan, EPA Office of Water and Wetland Protection (January 1989)	No net loss of remaining wetlands base	Dredge and disposal of dredged material in wetlands

[a] Applicable or relevant and appropriate requirements.

[b] Other factors to be considered.

9. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

CERCLA guidance (U.S. EPA 1988) requires that each remedial alternative be evaluated according to specific criteria. The purpose of the evaluation is to identify the advantages and disadvantages of each alternative, and thereby guide selection of the remedy offering the most effective and feasible means of achieving the stated cleanup objective. While the nine CERCLA evaluation criteria are all important, they are weighted differently in the decision-making process depending on whether they describe a required level of performance (threshold criteria), technical advantages and disadvantages (primary balancing criteria), or review and evaluation by other entities (modifying criteria). The 10 CB/NT candidate alternatives described in Section 8 were evaluated under CERCLA according to the following criteria:

- Threshold criteria
  - Overall protection of human health and the environment
  - Compliance with ARARs
- Primary balancing criteria
  - Long-term effectiveness and permanence
  - Reduction of toxicity, mobility, or volume through treatment
  - Short-term effectiveness
  - Implementability
  - Cost
- Modifying criteria
  - State and tribal acceptance
  - Community acceptance.

Alternatives are discussed in the relative order in which they best meet the criteria (e.g., those alternatives that most closely meet the criteria are discussed first). Following is a description of the evaluation criteria and the comparative evaluation of each candidate remedial alternative.

9.1 THRESHOLD CRITERIA

The remedial alternatives were first evaluated in relation to the threshold criteria: overall protection of human health and the environment and compliance with ARARs. The threshold criteria must be met by the candidate alternatives for further consideration as remedies for the Record of Decision.

9.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment requires evaluation of how well the remedy eliminates, reduces, or controls risks from each exposure pathway; whether there are unacceptable short-term or cross-media impacts; and whether exposure levels for carcinogens are brought within the acceptable risk range.

All alternatives except the no-action and institutional controls alternatives provide overall protection of human health and the environment. The no-action alternative fails to meet the stated cleanup objective throughout all problem areas because the existing threats to human health and the environment are unaltered. The institutional control alternative does not meet the threshold criteria for protection of human health and the environment in large portions of most problem areas because the exposure pathway to contaminants via ingestion of contaminated food species remains unmitigated, and adverse biological effects continue to occur for an unacceptable period of time. Because the no-action and institutional controls alternatives fail to meet threshold criteria, they were no longer considered as feasible remedial alternatives.

9.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Compliance with ARARs requires evaluation of the remedy for compliance with chemical-, location-, and action-specific ARARs (or justification for a waiver); and whether the remedy adequately considers other criteria, advisories, and guidelines.

All alternatives except the no-action and institutional controls alternatives are able to comply with ARARs at the site. All alternatives that require dredging may require variances as authorized by the Clean Water Act allowing for temporary contaminant and turbidity levels that may occur during dredging. Such waivers may be justified on the basis that long-term site cleanup will be attained. Because the no-action and institutional controls alternatives fail to meet the intent of CERCLA and the NCP, they were no longer considered feasible remedial alternatives.

9.2 PRIMARY BALANCING CRITERIA

Once an alternative satisfies the threshold criteria, five primary balancing criteria are used to evaluate other aspects of the potential remedies. Each alternative is evaluated by each of the balancing criteria. One alternative will not necessarily receive the highest evaluation for every balancing criterion. The balancing criteria evaluation are used in refining the selection of candidate alternatives for the site. The five primary balancing criteria are: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. Each criterion is further explained in the following sections.

9.2.1 Long-Term Effectiveness and Permanence

In evaluating long-term effectiveness and permanence, the magnitude of residual risks as well as the adequacy and reliability of controls must be examined. The three removal/treatment/upland disposal alternatives that utilize solidification, solvent extraction, and incineration have the highest degree of long-term effectiveness and permanence because they reduce the potential for future contaminant migration through destruction or immobilization of contaminants. Confined aquatic disposal and *in situ* capping also provide a high level of long-term effectiveness and permanence. Contaminated dredged material placed or covered in a subaquatic environment would isolate contaminants from the sensitive marine ecosystem. The potential for contaminant migration would also be very low because these two alternatives would maintain the same physicochemical conditions as the original material. Upland and nearshore disposal and land treatment are comparatively less effective and permanent than the alternatives named above. While engineering controls make upland disposal more secure than nearshore disposal or land treatment, all three of these alternatives have the potential for increased contaminant migration due to physicochemical changes in the dredged material during and after remediation.

9.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of alternatives based on the reduction of toxicity, mobility, or volume through treatment requires analysis of the following factors: the treatment process used, the toxicity and nature of the material treated, the amount of hazardous material destroyed or treated, the irreversibility of the treatment, the type and quantity of treatment residue, and the statutory preference for treatment as a principal element.

The remedies that offer the greatest reduction of toxicity, mobility, or volume through treatment are the three removal/treatment/upland disposal alternatives. The solvent extraction alternative reduces the mobility and volume of organic contaminants by removing them from the dredged material. The solidification alternative reduces the mobility of contaminants but increases the total volume of material. Incineration of contaminated dredged material eliminates organic contamination, but sediments with significant levels of inorganic contamination may be relatively unaffected by incineration. Land treatment of dredged material reduces the toxicity of organic chemicals, but the aerobic soil conditions required for this alternative may increase the mobility of metals.

While *in situ* capping and confined aquatic disposal are not treatment alternatives and therefore do not reduce the volume, toxicity, or mobility of contaminants within the sediment matrix itself, these alternatives isolate the material from the environment. Nearshore and upland disposal alternatives also do not reduce the volume, toxicity, or mobility of contaminated sediments and may actually increase the mobility of compounds in untreated dredged material due to changes in physico-chemical conditions (e.g., redox potential).

9.2.3 Short-Term Effectiveness

Evaluation of alternatives based on short-term effectiveness requires an evaluation of the effectiveness of protection for the community and workers during remedial actions, environmental impacts during implementation, and the amount of time required for remedial action objectives to be achieved.

The remedy having the highest degree of short-term effectiveness is *in situ* capping, which results in minimal exposure to workers and the public and no resuspension of sediment. In addition, *in situ* capping can be implemented very quickly. The three removal/disposal alternatives are the next most effective in the short term, resulting in minimal community exposure, low worker exposure, and minimal resuspension of contaminated sediments. Confined aquatic disposal is the most timely of the three removal/disposal options because it can be implemented quickly, whereas nearshore and upland disposal options involve siting and construction delays. The three removal/treatment/upland disposal alternatives have still lower short-term effectiveness, resulting in moderate community and worker exposure and some resuspension of contaminated sediment. Further, these remedies would require 2-3 years for bench and pilot scale testing or facility installation. The land treatment alternative is the least effective of all remedies in the short term, resulting in moderate community and worker exposure and requiring a long treatment period to attain remedial action objectives.

9.2.4 Implementability

The implementability criterion has three factors requiring evaluation: technical feasibility, administrative feasibility, and the availability of services and materials. Technical feasibility requires an evaluation of the ability to construct and operate the technology, the reliability of the technology, the ease of undertaking additional remedial action (if necessary), and monitoring considerations. The ability to coordinate actions with other agencies is the only factor for evaluating administrative feasibility. The availability of services and materials requires evaluation of the following factors: availability of treatment, storage capacity, and disposal services; availability of necessary equipment and specialists; and availability of prospective technologies.

In situ capping is the most easily implemented remedial alternative in situations where navigational requirements do not impose depth restrictions. This option is a demonstrated technology, and equipment and methods for implementation are readily available. Further, sediment monitoring is easily implemented, operation and maintenance requirements are minimal, and multi-agency approval is feasible. Confined aquatic disposal is the next most easily implemented remedial alternative, having all of the benefits of *in situ* capping except that removal and subsequent confinement is less easily implemented. The confined aquatic disposal alternative can be implemented onsite in a manner that allows continued navigation within the waterway. The nearshore and upland disposal alternatives must address more contaminant migration pathways than the confined aquatic disposal and *in situ* capping alternatives. However, there is also more opportunity to engineer adequate control mechanisms and monitoring programs relative to the open-water alternatives. The nearshore and upland alternatives can be implemented at onsite locations (described in the feasibility study); however, because none of these locations have been specifically identified as available and approved for disposal of contaminated dredged material, they rank slightly lower.

The land treatment alternative is rated relatively low for implementability. This alternative requires extensive bench and pilot scale testing, monitoring during active treatment, and agency review for treatment facility siting and operation. Further, site availability for treatment is uncertain. The three removal/treatment/upland disposal options, which are only in the developmental or conceptual stages, are least easily implemented among all the remedial alternatives. System maintenance for these alternatives is intensive during remediation. In addition, approvals depend on pilot testing, and equipment for solidification and solvent extraction processes is either in developmental stages or unavailable. The incineration alternative is more feasible than the solvent extraction or solidification alternatives due to the current availability of incineration equipment.

9.2.5 Cost

In evaluating project costs, an estimation of capital costs, operation and maintenance costs, and present worth costs are required. The cost analysis that was conducted for each alternative in the feasibility study had several errors that resulted in underestimates of capital and monitoring costs. Major errors included underestimation of unit costs for dredging and failure to consider the excess volume of material requiring disposal due to the swelling of sediments during the disturbance of dredging operations. Revised cost estimates were developed in the Record of Decision for the four confinement options represented by the preferred alternative. In the following discussion, cost estimates developed for the feasibility study are used to compare costs among major categories of alternatives. The revised cost estimates developed for the Record of Decision are used to compare costs among confinement alternatives.

In the feasibility study, remediation costs for each problem area were developed for selected subsets of the 10 candidate alternatives. The subset of the 10 candidate alternatives considered to be applicable to a given problem area was determined on the basis of waste characteristics (e.g., solvent extraction was determined to be appropriate in areas where organic contamination was the major form of contamination) and problem area characteristics (e.g., *in situ* capping was not considered for waterways with active shipping traffic). Costs were developed for two options: 1) active remediation of all sediments exceeding the long-term cleanup objective, and 2) active remediation of sediments not predicted to recover to the long-term cleanup objective within a reasonable timeframe (i.e., 10 years). Candidate alternative costs developed in the feasibility study that are associated with Option 2 are presented for the eight problem areas addressed in this Record of Decision in Table 11. Although the feasibility study and proposed plan recommended a performance-based Record of Decision that could utilize various sediment remedial alternatives, preferred alternatives were identified for each CB/NT problem area. Specific alternatives were recommended based on a combination of problem area characteristics, schedule of source control, and tentative disposal site availability. The total estimated cost of the preferred alternatives for the eight problem areas described in this Record of Decision was approximately $17,500,000 for FS estimates

Feasibility study costs associated with incineration were the greatest, and exceeded costs associated with all of the confinement options by a factor of 10. Solvent extraction was the next most costly, exceeding costs associated with the confinement alternatives by a factor of 5. Solidification was the third most costly alternative, typically exceeding the confinement options costs by a factor of 2. The costs associated with land treatment were comparable to the costs associated with upland disposal, the most costly of the confinement options.

Feasibility Study Cost Est.

TABLE 11. COSTS ASSOCIATED WITH CANDIDATE ALTERNATIVES[a,b]
(THOUSANDS OF DOLLARS)

Problem Area	*In Situ* Capping	Confined Aquatic Disposal	Nearshore Disposal	Upland Disposal	Solidification/ Upland Disposal	Solvent Extraction/ Upland Disposal	Incineration/ Upland Disposal	Land Treatment
Head of Hylebos								
Capital	--	1,731	5,338	9,503	--	45,880	104,275	--
O&M[c]	--	376	421	572	--	551	551	--
Total	--	2,107	5,759[d]	10,075	--	46,431	104,826	--
Mouth of Hylebos								
Capital	--	1,773	5,597	10,013	--	48,568	110,461	--
O&M	--	289	336	475	--	453	453	--
Total	--	2,062[d]	5,933	10,488	--	49,021	110,914	--
Sitcum								
Capital	--	544	1,612	2,887	4,400	--	--	--
O&M	--	125	139	185	178	--	--	--
Total	--	669	1,751[d]	3,072	4,578	--	--	--
St. Paul								
Capital	672	1,341	4,234	7,568	--	36,742	83,566	6,154
O&M	1,282	218	231	352	--	335	335	222
Total	1,954[d]	1,559	4,465	7,920	--	37,077	83,901	6,376
Middle								
Capital	--	461	1,409	2,481	3,791	--	--	--
O&M	--	179	165	205	199	--	--	--
Total	--	640	1,574[d]	2,686	3,990	--	--	--

TABLE 11. (Continued)

Problem Area	*In Situ* Capping	Confined Aquatic Disposal	Nearshore Disposal	Upland Disposal	Solidification/ Upland Disposal	Solvent Extraction/ Upland Disposal	Incineration/ Upland Disposal	Land Treatment
Head of City								
Capital	--	3,372	10,454	18,658	28,260	--	--	--
O&M	--	485	572	869	828	--	--	--
Total	--	3,857[d]	11,026	19,527	29,088	--	--	--
Wheeler-Osgood								
Capital	144	139	321	504	--	2,377	5,337	606
O&M	252	31	31	39	--	38	38	86
Total	396	170[d]	352	543	--	2,415	5,375	692
Mouth of City[d,e]								
Capital	--	233	682	1,174	--	5,726	12,992	--
O&M	--	53	51	70	--	67	67	--
Total	--	286	733	1,244	--	5,793	13,059	--

[a] Reference: Tetra Tech (1988a).

[b] 10 year natural recovery included in alternative.

[c] O&M = Operation and maintenance.

[d] Preferred alternatives in CB/NT feasibility study.

[e] Institutional controls: capital cost 6, O&M 345, total 351.

Revised costs associated with the four major confinement options were developed for this Record of Decision and are summarized in Table 12. The rationale for revisions to the costs developed in the feasibility study are provided in Section 10.4. As described in Section 11.3, the confined aquatic disposal option is most likely to be implemented on an areawide basis due to site availability considerations. Therefore, it is the only option for which areawide costs are presented in Table 13. The revised areawide cost estimate for sediment remediation associated with each of the eight problem areas addressed in this Record of Decision is approximately $32,300,000, assuming the use of *in situ* capping at the St. Paul Waterway and confined aquatic disposal in the remaining seven problem areas. The costs of the other confinement options are presented as a factor of the confined aquatic disposal costs (i.e., alternative cost/confined aquatic disposal cost). The upland disposal alternative, as noted in the evaluation of feasibility study costs, is the most costly of the confinement alternatives. However, the total range in costs estimated for all four confinement options is never greater than a factor of 7, and is more typically a factor of 4 for the different problem areas. Costs associated with *in situ* capping and nearshore disposal are the lowest. The low costs associated with nearshore disposal are explained in Section 10.4 as a component of planned construction projects that require fill material.

9.3 MODIFYING CRITERIA

The modifying criteria are used in the final evaluation of remedial alternatives. The two modifying criteria are state and tribal acceptance and community acceptance. For both of these elements, the factors considered in the evaluation are the elements of the alternative which are supported, the elements of the alternative which are not supported, and the elements of the alternative that have strong opposition. Under CERCLA, tribes are provided substantially the same opportunities for project oversight and implementation as those afforded to states. At present, the opportunity for CERCLA oversight by tribes is often limited by environmental program capability and experience relative to state programs. In the case of the CB/NT project, the state is afforded co-lead status with EPA, whereas the Puyallup Tribe is currently afforded status as a supporting agency, as described in Sections 3.4 and 5.1.

9.3.1 State and Tribal Acceptance

State and tribal acceptance is addressed in the Record of Decision rather than in the CB/NT feasibility study because of their changing roles in the project during the public comment period.

As indicated previously, Ecology was the lead management agency for the CB/NT project under a cooperative agreement with EPA throughout the study phase, including the remedial investigation, feasibility study, and public comment period. State acceptance during that period was based on their role as lead management agency. Ecology was instrumental in developing the five key elements of the selected remedy. Planning schedules for integrated project implementation were jointly prepared by Ecology and EPA. During the public comment period, Ecology requested that EPA assume the lead for developing the Record of Decision due to resource constraints. However, Ecology has continued to play a key role in the development of the Record of Decision.

Continued state acceptance of the selected remedy is based on two factors. First, the selected remedy is designed to be as consistent as possible with emerging state regulations regarding the management of contaminated sediments. Second, Ecology has been established as the lead oversight agency for Operable Unit 05 (Source Control), the first and most critical step in overall project implementation. During Record of Decision development the state stressed the need to clarify several project implementation issues. For example, the process by which EPA and Ecology will determine the levels of source control which trigger the initiation of sediment remedial design and sediment remedial action in each problem area was raised as an important issue. Discussions prompted clarification and adjustments to the overall project schedule. State acceptance of the selected remedy is evidenced by a letter of concurrence in Appendix A.

TABLE 12. ESTIMATED COSTS FOR THE FOUR CONFINEMENT OPTIONS[a] (THOUSANDS OF DOLLARS)

Alternative	Waterway: Head of Hylebos	Mouth of Hylebos	Sitcum	St. Paul	Middle	Head of City	Wheeler-Osgood	Mouth of City[b]
Volume (yd^3)	217,000	231,000	66,000	174,000	57,000	426,000	11,000	--
In-Waterway Confined Aquatic Disposal								
Containment cost	4,840	3,300	1,950	--	2,670	5,110	967	--
Monitoring cost (annual)	222	162	93	--	76	144	12	11.7
Total cost[c]	8,140	5,710	3,360	--	4,150	7,630	1,360	107
Cost normalized to confined aquatic disposal[d]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
***In Situ* Capping**								
Containment cost	--	--	--	1,200	--	--	--	--
Monitoring cost (annual)	--	--	--	27	--	--	--	--
Total cost[c]	--	--	--	1,820	--	--	--	--
Cost normalized to confined aquatic disposal[d]	0.61	0.56	0.58	0.45	0.49	0.50	0.66	1.0
Nearshore Disposal								
Cost normalized to confined aquatic disposal[d]	0.71	0.87	0.79	0.83	0.64	0.92	1.3	1.0
Upland Disposal								
Cost normalized to confined aquatic disposal[d]	1.9	2.7	1.5	2.8	1.8	3.2	1.6	1.0

TOTAL AREAWIDE COST: 32,300[e]

TABLE 12. (Continued)

[a] All alternatives incorporate natural recovery. See Sections 10.4 and 11.3 for further explanations and assumptions.

[b] Costs for Mouth of City Waterway represent monitoring costs only.

[c] Contingency - 20%
Administration - 8%
Discount rate - 7%
Includes monitoring over 10 years.

[d] Presented as a factor of confined aquatic disposal costs $\left(\frac{\text{indicated alternative}}{\text{confined aquatic disposal}} \right)$

[e] Combines *in situ* capping cost for St. Paul with in-waterway confined aquatic disposal for remaining seven problem areas.

Acceptance by the Puyallup Tribe has also changed over the duration of the project. Through most of the remedial investigation and feasibility study the tribe provided comments on the project as a member of the Technical Oversight Committee. The tribe's comments on draft documents and their feedback in meetings were primarily concerned with the need to adequately address chronic effects in the marine environment and to ensure protection of fisheries resources. As a supporting agency for continued project management, the tribe has continued to express concern about the permanence and effectiveness of the selected remedy. Many tribal members rely on subsistence fishing in Commencement Bay and contaminants such as PCBs and dioxins are of particular concern because of their toxicity, persistence, and tendency to bioaccumulate in the marine environment. Although the tribe has expressed concern about the impact of hazardous substances on fisheries resources and human health, the Puyallup Environmental Commission regards the selected remedy as an important means of mitigating and preventing those impacts. Tribal acceptance of the selected remedy is evidenced by a letter of concurrence (Appendix A) which expresses both support for the remedy and concerns that it may be difficult to implement in a manner that will be fully protective. The Puyallup Tribe's concerns may be addressed through continued participation in the enforcement activities outlined in Section 3.

9.3.2 Community Acceptance

The agencies have carefully considered all comments submitted during the public comment period and have taken them into account during the selection of the remedy for the CB/NT project as described in this Record of Decision. Based on the comments received during the public comment period, members of the community are supportive of the overall approach that combines source control, natural recovery, and sediment remediation (if necessary). Most commenters agreed that there are demonstrable adverse environmental impacts in the CB/NT sediments, that the area should support a multiplicity of uses (e.g., commercial, recreational), and that source control should be a high priority.

Commenters expressed numerous divergent opinions on several key issues. These included the environmental and human health risks posed by the site, the proposed cleanup goals, the feasibility of and timeframe for source control, and the protectiveness and proposed role of natural recovery as a component of the remedy. For example, some commenters said that there is no significant human health risk, while others argued that the human health risk is far greater than the feasibility study estimate. These various divergent comments have been considered in the selection of the remedy and responded to in the Responsiveness Summary (see Appendix B).

Some commenters offered new information which led the agencies to modify the selected remedy from the proposed plan. The Puyallup Tribe of Indians and the National Oceanic and Atmospheric Administration raised significant habitat preservation and fisheries enhancement issues that resulted in the agencies giving these issues additional weight in the remedy. Most commenters believed that the estimates for feasible source control and the time necessary to achieve source control were overly optimistic. These estimates have been revised. Remedial costs and volume estimates were challenged, and upon review, the agencies have revised these estimates upward. ASARCO provided new information about the sediments along the Ruston-Pt. Defiance Shoreline which resulted in that problem area being separated into a new operable unit.

9.4 OVERALL RANKING

The confinement alternatives (3, 4, 5, and 6) represent the most effective and feasible means of achieving overall protection of human health and the environment at the CB/NT site. This high overall ranking for confinement alternatives is a reflection of the general characteristics of problem sediments at the eight CB/NT problem areas addressed here. CB/NT sediments are characterized by relatively low concentrations of contaminants which often have a high affinity for sediment particles, and the total volume of sediments requiring active remediation is large (i.e., greater than 1 million cubic yards as estimated in the feasibility study). Confinement of CB/NT sediments therefore offers the most appropriate and cost-effective means of achieving the cleanup objectives for this site.

All confinement alternatives can be implemented at the CB/NT site, minimizing the costs and risks of transporting contaminated sediments to distant locations. Onsite disposal is also more acceptable under Superfund policy and guidance than the offsite disposal of untreated waste materials. In addition, performance monitoring for all confinement options uses well established sampling and analytical methods. Given appropriate siting conditions, the *in situ* capping alternative can be most readily implemented, and because it does not involve dredging of contaminated sediments, eliminates potential problems associated with contaminant redistribution during sediment resuspension. Both *in situ* capping and in-waterway confined disposal alternatives have the added advantage of preserving the original physicochemical conditions, which limits the potential for contaminant mobilization associated with the transition from anaerobic to aerobic conditions. However, in environments with a high potential for ship scour, currents, and wave action, these two alternatives are more susceptible to disruption of the cap, and added protective measures need to be incorporated into the design characteristics to ensure permanence. For example, in navigable waterways the confined aquatic disposal alternative must be implemented so that the top of the cap neither impedes shipping traffic, nor is susceptible to ship scour. Overdredging to such a depth may require the placement of a significant amount of clean dredged material out of the waterway to accommodate some bulking of contaminated sediments at the disposal site.

In contrast, implementability of nearshore and upland disposal is much more dependent on the availability of limited disposal sites. Potential loss of intertidal and wetland habitat is an important consideration in both cases. However, nearshore disposal can proceed rapidly and be cost-effective when the disposal facility is developed in conjunction with authorized shoreline development projects (e.g., fill operations). Habitat mitigation will be a key component of such projects as required by Section 404 of the Clean Water Act. Upland disposal is also a viable option that can be incorporated into property development projects or implemented on some of the remaining vacant land in the study area.

Aerobic conditions at nearshore and upland facilities may enhance contaminant mobility; however, a greater degree of control in the design, construction, and maintenance of the confinement system is possible. While contamination of groundwater is more likely in the event of failure at an upland disposal facility, adequate engineering and monitoring can be developed to control contaminant migration. Transport of contaminated sediment to the upland facility would also pose additional worker and public exposure hazard in the event of a spill. Loss of intertidal habitat is an important disadvantage associated with nearshore disposal.

In general, all of the treatment alternatives are more effective than the confinement alternatives at reducing the toxicity, mobility, and volume of contamination; however, in most cases available treatment technologies are not appropriate to the chemical mixtures (i.e., mixed metals and organic compounds) that characterize contaminated sediments at the CB/NT site. The greater permanence of the treatment alternatives relative to the confinement alternatives does not justify the increased cost of treating sediments at the CB/NT site. CB/NT problem sediments are relatively low concentration/high volume wastes for which treatment is not considered appropriate or cost-effective under Superfund. In addition, these alternatives are not as readily implemented as the confinement alternatives, in some cases requiring 2-3 years of pilot tests, and therefore offering less certainty in terms of long-term protection and less capability of mitigating significant threats to human health and the environment in the short-term.

10. SELECTED REMEDY

Based upon consideration of the requirements of CERCLA and the NCP, the detailed analysis of the alternatives, and public comments, EPA, the state of Washington, and the Puyallup Tribe have determined that Source Control/Natural Recovery/Sediment Confinement is the most appropriate remedy for achieving the CB/NT cleanup objectives. The selected remedy represents a generalized form of Candidate Alternatives 3, 4, 5, and 6 by incorporating all four options for confinement of contaminated sediments: in-place capping, confined aquatic disposal, nearshore disposal, and upland disposal. The selected remedy is also represented by a specific combination of the key elements described in Section 8.2: site use restrictions, source control, natural recovery, sediment remedial action, and monitoring. It is expected that the selected remedy will be protective of public health and the environment, and will meet federal, state, and tribal ARARs. The project objectives are to be achieved in a 15-20 year period by implementing these key elements in an interdependent, integrated fashion. In general, however, because of differences regarding location, environmental characteristics, and status of source control between problem areas, the selected remedy will be implemented independently in each of the eight CB/NT problem areas.

A remedy utilizing a generalized sediment remediation element was selected because all four confinement options provide an effective means of protecting human health and the environment at the CB/NT site. They are also comparable in terms of overall feasibility and cost-effectiveness. By allowing the flexibility to utilize any one or combinations of the four confinement options in each problem area, the selected remedy maintains the greatest degree of consistency with the intent of the 1989 PSWQA plan (PSWQA 1988; Element S-4, Sediment Disposal Standards). It also offers the best opportunity to implement the remedy in a timely manner while integrating the following factors when appropriate:

- Construction or development projects within the waterways
- New information gained during the remedial design phase
- Newly available disposal sites.

10.1 CLEANUP OBJECTIVES

The objective of the selected remedy is to achieve acceptable sediment quality in a reasonable timeframe. This objective has been defined in terms of biological and chemical tests, as described in Section 7 and summarized in Section 8.1. As described in Section 8.2, sampling and test evaluation protocols for environmental effects, as well as the AET database, are to remain consistent with any adjustments adopted by the Puget Sound Estuary Program. Because the objective of the selected remedy is to achieve the sediment quality goal in a reasonable timeframe, natural recovery is integrated into the overall remedy. Natural recovery considerations are used to identify sediment remedial action levels that delineate sediments that are allowed to recover naturally from those that require active sediment cleanup. The sediment quality objective also applies to source control requirements. Monitoring of sources and sediments will be used to determine the effectiveness of source controls. Habitat function and enhancement of fisheries resources will also be incorporated as part of the overall project cleanup objectives. For example, the physical characteristics and placement of material used for capping contaminated sediments in the marine environment will be required to provide a suitable substrate and habitat for aquatic organisms that may utilize that environment.

10.2 KEY ELEMENTS OF THE SELECTED REMEDY

The selected remedy includes the following major elements:

- Site use restrictions
- Source control
- Natural recovery
- Sediment remedial action (i.e., confinement and habitat restoration)
- Monitoring.

10.2.1 Site Use Restrictions

Site use restrictions consist mainly of public warnings and educational programs intended to reduce potential exposure to site contamination, particularly ingestion of contaminated seafood. Local health advisories are an integral part of the overall remedy because the ultimate objective will be achieved over a 15-20 year period.

10.2.2 Source Control

The general characteristics of source control at the CB/NT site are described in Section 8.2.2. Implementation schedules for source control activities in the eight high priority problem areas addressed in this Record of Decision are summarized in Appendix C.

The success of source control is evaluated using monitoring data, typically collected as part of permit requirements. In addition to existing source control programs, Ecology is developing several source-related regulations and requirements to be implemented statewide. Ecology requirements that are specific to Puget Sound, and which may be integrated into source control activities, include the following:

- Standards for identifying and designating sediments that have acute or chronic adverse effects on biological resources or that pose a significant health risk to humans
- Definitions of acceptable source control technologies (i.e., AKARTs) for various types of sources (e.g., pulp mills, sewage treatment plants, shipyards, storm drains)
- Administrative rules for establishing receiving water and sediment dilution zones in the vicinity of wastewater discharges (the sediment dilution zone is commonly referred to as a sediment impact zone, a specific area adjacent to a municipal or industrial discharge where sediment standards are relaxed by permit; sediment impact zones may be established when technical feasibility, time, or cost limits the ability of a discharger to comply with sediment standards)
- Administrative rules for establishing sediment recovery zones in the vicinity of wastewater discharges (a sediment recovery zone is a variance for cleanup actions to allow consideration of time, cost, and technical feasibility in meeting sediment standards)
- Guidelines for determining when the concentration or loading rate of chemical contaminants discharged from a source could exceed sediment standards
- Chemical-specific concentrations or loading limits for source permits based on AKARTs.

As the regulations and requirements are being developed, Ecology's Sediment Management Unit staff have periodically outlined how they will be implemented. Effluent limitations will be derived for those contaminants remaining in an effluent stream after applying AKARTs. Permit requirements will be used initially to address effluent and treatment system analyses when sediment quality is determined to violate interim sediment quality values, or final sediment quality standards, when adopted. Sediment quality standards (or interim values) will not explicitly be used to derive effluent limits, but they will be considered in the selection of appropriate treatment technologies. A sediment impact and/or recovery zone, which may be based initially on standardized size constraints, may be established when treatment technology is inadequate. Results from monitoring effluent and sediments will be used as feedback to technology requirements during permit renewals and modifications. If monitoring reveals problems in meeting receiving water quality standards, sediment quality standards, or permit requirements, then the adequacy of AKARTs will be re-evaluated, technology more stringent then AKARTs may be considered, beyond-pipe maintenance may be required, or the sediment impact zone and/or recovery zone size may be altered.

10.2.3 Natural Recovery

Natural recovery of some or all of a given problem area may occur through chemical degradation, diffusive losses across the sediment-water interface, and burial and mixing of contaminated surface sediments with recently deposited clean sediments. Areas that are expected to recover naturally within 10 years of sediment remedial action (based on modeling results confirmed by monitoring data) are initially exempt from sediment remedial action (i.e., confined disposal). However, monitoring to confirm the long-term effectiveness of the recovery will be required as part of the overall CB/NT selected remedy. Should subsequent monitoring data indicate that natural recovery is not viable in a reasonable timeframe, the need for active sediment remediation may be reconsidered. Areas that are predicted to recover naturally are defined by the following performance criteria for priority problem chemicals particular to each problem area, as described in the feasibility study:

- **Minimum Chemical Concentration**: Surface sediment concentrations exceed the long-term cleanup objective (illustrated for indicator chemicals in Table 13)
- **Maximum Chemical Concentration**: Surface sediment concentration are less than sediment remedial action cleanup levels (illustrated for indicator chemicals in Table 13).

The recovery factor is derived from a mathematical model, SEDCAM, that relates recovery rate to source loading, sedimentation rate, surface sediment mixing due to bioturbation and physical disturbance, and existing levels of contamination (Tetra Tech 1988a). Recovery factors developed in the feasibility study for selected indicator chemicals are summarized in Table 13. These recovery factors will be modified on the basis of source loading and sediment data collected during remedial design.

10.2.4 Sediment Remedial Action

The estimated surface areas and sediment volumes in the CB/NT problem areas that are subject to sediment remedial action are summarized in Table 14. These areas and volumes are reduced from the areas and volumes that exceed sediment quality objectives on the basis of recovery factors developed during the feasibility study. These areas and volumes will be revised on the basis of sediment sampling during remedial design. Tentative implementation schedules for sediment remedial action are summarized in Appendix C. These schedules are highly dependent upon the successful implementation of source control actions.

Results of sediment sampling during the remedial design phase will be used to refine estimates of the areal extent and depth of contamination to be addressed by the sediment remedial alternative. These data will also be used to identify temporal changes in problem chemical concentrations resulting from sedimentation and from source control actions that occurred after the remedial investigation/feasibility study sampling phase. Documented changes then will be used to refine

TABLE 13. INDICATOR CHEMICALS AND RECOVERY FACTORS

Problem Area	Indicator Chemical	Sediment Quality Objective[a]	10-year Recovery Factor[b]	Remedial Action Level[a,c]
Head of Hylebos	PCBs	150	1.6	240
	Arsenic	57	1.7	97
	HPAH	17,000	1.9	32,000
Mouth of Hylebos	PCBs	150	2.0	300
	Hexachlorobenzene	22	4.6	100
Sitcum	Copper	390	2.9	1,100
	Arsenic	57	2.9	160
St. Paul	4-Methylphenol	670	1.9	1,300
Middle	Mercury	0.59	1.2	0.71
	Copper	390	1.2	470
Head of City	HPAH	17,000	1.3	22,000
	Cadmium	5.1	1.3	6.6
	Lead	450	1.3	580
	Mercury	0.59	1.3	0.77
Wheeler-Osgood	HPAH	17,000	1.2	20,000
	Zinc	0.59	1.2	490
Mouth of City	HPAH	17,000	1.5	25,000
	Mercury	0.59	1.5	0.89

[a] Concentration, expressed as µg/kg dry weight for organics and mg/kg dry weight for metals.

[b] Maximum enrichment ratio (i.e., observed concentration/cleanup objective) in surface sediment that will recover (i.e., return to 1.0) in 10 years.

[c] Target cleanup levels will change based on source monitoring and sediment remedial design data.

TABLE 14. ESTIMATED SURFACE AREAS AND VOLUMES OF SEDIMENTS SUBJECT TO SEDIMENT REMEDIAL ACTION[a]

Waterway	Area	Volume
Head of Hylebos	217	217
Mouth of Hylebos	115	230
Sitcum	66[b]	66[b]
St. Paul	87	174
Middle	114	57
Head of City	171	426
Wheeler-Osgood	22	11
Mouth of City	0	0
TOTAL	792	1,181

[a] Areas are reported in units of 1,000 square yards. Volumes are reported in units of 1,000 cubic yards.

[b] Includes sediment for which biological effects were observed for nonindicator compounds.

predictions of the rate of problem area recovery (i.e., to develop refined recovery factors) and to re-evaluate the need to implement sediment remedial action. In addition, sediment sampling conducted during remedial design will provide a baseline assessment for subsequent monitoring to determine the success of remedial action. Guidelines for developing source monitoring and sediment remedial design sampling programs are provided in the integrated action plan (PTI 1988).

Habitat mitigation and fisheries enhancement projects will also be incorporated into sediment remedial actions. The scope and focus of these activities will be determined on a site specific basis during remedial design. For example, the habitat restoration protocols being developed by EPA's Region 10 Wetlands Program and Puget Sound Estuarine Program will be incorporated into the evaluation and design process.

In the following sections, the general characteristics of the four confinement options that constitute the sediment remedial action element of the selected remedy are described in terms of the factors that may influence their selection for all or a portion of the problem area. The choice of confinement option ultimately applied to a site will depend on the results of the remedial design phase, the status of available remedial technologies evaluated during remedial design, and availability of disposal sites. These confinement options are described in greater detail in Section 8.3 and in the feasibility study. The ultimate selection of a specific confinement option or combination of confinement options for a particular problem area will also be affected by economic and development considerations.

In-Place Capping—*In situ* capping involves containment and isolation of contaminated sediments through placement of clean material on top of existing substrate. In-place capping is inappropriate for environments with a high potential for ship scour, current action, or wave action because these disturbances can lead to cap erosion. Currents in the CB/NT problem areas are primarily tidal in origin and result in generally quiescent flow conditions. Maintenance dredging precludes the use of capping in areas maintained for shipping navigation. Capping of sediment with high concentrations of unstable organic matter may result in methane formation which can produce bubbles and may potentially disrupt the cap as they float to the surface. The effect of this process on cap integrity and contaminant migration should be evaluated in pilot studies. The primary environmental impacts associated with implementation of this alternative is loss of existing benthic and intertidal habitat at the site. Because of the high value placed on intertidal habitat, any loss of intertidal habitat would require corresponding habitat mitigation.

In-place capping may be determined appropriate during remedial design for those portions of a problem area that are not subject to shipping traffic, or where shipping traffic could be restricted. This alternative could also be included as a partial site remedy if remedial design results suggest that it is appropriate to consolidate sediments and restrict navigation in a portion of the waterway.

In-place capping has been selected as the confinement option appropriate to St. Paul Waterway. As described in Section 6.4, the Simpson Tacoma Kraft Company, in cooperation with Ecology, designed and implemented the capping operation that began in December 1987 and ended in September 1988. The capping project was coordinated with related remedial actions, including dredging for outfall alignment, placement of material dredged from the outfall, dredging along the chip unloading dock and the new chip unloading facility, and intertidal habitat enhancement. Future EPA enforcement actions will expand response actions (e.g., sediment monitoring activities) at this problem area.

Confined Aquatic Disposal—Confined aquatic disposal involves the subaquatic disposal and capping of contaminated sediments. The hydraulic energy associated with the quiescent waterways in the CB/NT problem areas is lower than in other shallow-water environments exposed to more direct wave action. However, propeller wash and ship scour would be expected to significantly increase subsurface energy in the shallow-water environment. If sited in shallow water, the disposal site should be located in an area that would not be dredged, and where shipping traffic could be restricted. If sited in an active shipping area where future dredging is expected, the contaminated dredged material and cap must be placed deep enough to preclude cap disruption associated with prop wash and dredging activities. Details of in-waterway confined aquatic disposal are described in the feasibility study (Tetra Tech 1988a) and Phillips et al. (1985).

Nearshore Disposal—Nearshore disposal involves dredging of contaminated sediments followed by confined disposal in the nearshore environment. The primary environmental impact associated with implementation of this alternative is loss of existing benthic and intertidal habitat at both the dredge and disposal sites. Because of the intertidal location of the disposal site and the high value placed on intertidal habitat, this alternative would require a habitat mitigation component. As a general policy for the CB/NT site, EPA would prefer that the nearshore disposal option only be utilized in conjunction with projects that would otherwise be permitted commercial development. The intent of this policy is to minimize unnecessary impact to nearshore habitat, consistent with the provisions of Clean Water Act Section 404. Also, the influence of tides and groundwater on contaminant transport would be much greater for nearshore confinement than for confined aquatic disposal or upland disposal. In addition, altered redox conditions may increase the mobility of metals, depending upon the level of placement within the disposal site. To the maximum extent practical, sediments containing predominantly inorganic contaminants would be placed below the water table level in the confinement facility to minimize contaminant mobility. Nearshore confinement may be determined appropriate during remedial design for a problem area if it can effectively be integrated into an ongoing construction and fill project.

Upland Disposal—Dredging followed by upland disposal onsite would involve the transfer of contaminated dredged material to a confinement facility that is not tidally influenced. The primary environmental impact of this remedial alternative would be destruction of the existing benthic and intertidal habitat at the dredging site. As with all alternatives that involve dredging, resuspension of contaminated sediment would also be a concern. Destruction of habitat at the upland disposal site is likely to be less significant than at a nearshore site. However, implementation of this alternative would involve risks to area groundwater resources in the event of contaminant leakage from the containment facility. Transport of contaminated dredged material to the upland facility would also pose additional worker and public exposure hazards in the event of system failure or spill. Disposal in an upland facility would result in significant physicochemical changes in dredged material that could increase mobility of metal and organic contaminants.

10.2.5 Monitoring

Source monitoring and sediment remedial design sampling and monitoring play a key role in the refinement of the remedial alternative, because for many problem areas the data analyzed in the remedial investigation and feasibility study were not adequate to 1) fully determine the effectiveness of source controls implemented to date, or 2) define the volume of sediment exceeding the cleanup objective with a high degree of confidence. Furthermore, several source control actions have been implemented since the source loading analysis was conducted. Data gaps associated with sources will be addressed by the source control programs that are directed by Ecology. Source monitoring data will be developed to characterize the discharge or release, the receiving body of water, and associated sediments, according to both chemical and biological parameters. Source loading data (i.e., measurements of the amount of contaminant discharged to the various problem areas) provide the most important information for determining the effectiveness of source controls, the relative contributions of problem chemicals by ongoing sources, and the need for additional source controls.

Monitoring during sediment remedial design can be used to assess CB/NT feasibility study predictions of the rate of natural recovery of a problem area and the estimated cleanup volume. For example, if a problem area was predicted to have a very slow rate of natural recovery, but results of the remedial design sampling indicate that the volume of sediment exceeding cleanup goals had decreased significantly since the CB/NT feasibility study and remedial investigation sampling, the decision to implement sediment remedial action may be re-evaluated. Similarly, if a significantly slower rate of recovery is documented in areas predicted to recover naturally within a reasonable time, sediment remediation may be required, rather than reliance on natural recovery. Additional monitoring may be advisable depending on the time lapse before implementation of the sediment remedial alternative. Sediment monitoring will be required during sediment remedial action to establish a baseline from which to evaluate the effect of source control and natural recovery in areas where natural recovery is predicted to be a viable means of achieving the project cleanup objectives.

Monitoring within problem areas, at disposal sites, and at habitat mitigation/restoration areas developed as part of the sediment remedial action within CB/NT problem areas will be conducted to evaluate the effectiveness of the remedy in achieving the sediment quality objectives and in relation to habitat function, especially relative to fisheries resources. Sediment monitoring will be used to develop data for priority problem chemicals within each problem area as described in the feasibility study and other chemicals that may become of concern to EPA through source monitoring or other related studies. Biological effects data may also be developed at the option of the PRPs or the agencies to confirm problem area characteristics relative to the sediment quality objectives. Habitat evaluation will be conducted in accordance with habitat restoration protocols that are currently being developed by EPA's Region 10 Wetlands Program and Puget Sound Estuary Program. These protocols will be incorporated into habitat evaluation in the CB/NT problem areas before and after sediment remedial action at both dredging and disposal sites. These protocols are being designed to quantitatively assess the characteristics of an area that contribute to habitat function (i.e., feeding, refuge, and reproduction).

10.3 IMPLEMENTATION

Source identification, characterization, and control activities are underway in all eight problem areas. In general, the remedial alternatives selected for the different problem areas will be implemented independently of one another. For the St. Paul Waterway, source control and sediment remedial action implemented under a state consent decree were completed in September 1988. The success of these actions is being evaluated through a monitoring program, which is to be expanded by EPA to ensure consistency with this Record of Decision and long-term protectiveness of the action. In the remaining seven problem areas, key elements of the selected alternative will be conducted together or in sequence over a 15-20 year period. Implementation schedules for source control and sediment remedial activities for all eight problem areas have been developed for planning purposes, and are provided in Appendix C. The timing of source control actions is highly dependent on the availability of agency staff and financial resources, the success of negotiations with PRPs, and the results of source investigation and control actions.

The successful implementation of the selected remedy requires that the key elements of this Record of Decision be carried out in an integrated, interdependent fashion within each problem area. Relationships among the key decision points and key elements of the selected remedy are illustrated in Figure 18.

After signature of the Record of Decision, Ecology will continue to identify CB/NT sources and enforce appropriate source control measures, and enforce those measures. Source monitoring will be required by Ecology to evaluate the effectiveness of source control measures. Ecology and EPA will evaluate the source monitoring data to determine when source control is sufficient to begin the remedial design phase for sediment remedial action in each problem area. Several factors will be considered in this evaluation, including the possibility of unidentified major sources within the problem area, the status of source control for known major sources, and the possible cumulative effects from other CB/NT sources.

For each problem area, the remedial design phase will begin with sediment sampling to refine the volume estimate of contaminated sediments exceeding the sediment quality objective and the predicted natural recovery rate. This sampling data will be used by EPA to determine whether the problem area, or portions thereof, will achieve sediment quality objectives through natural recovery

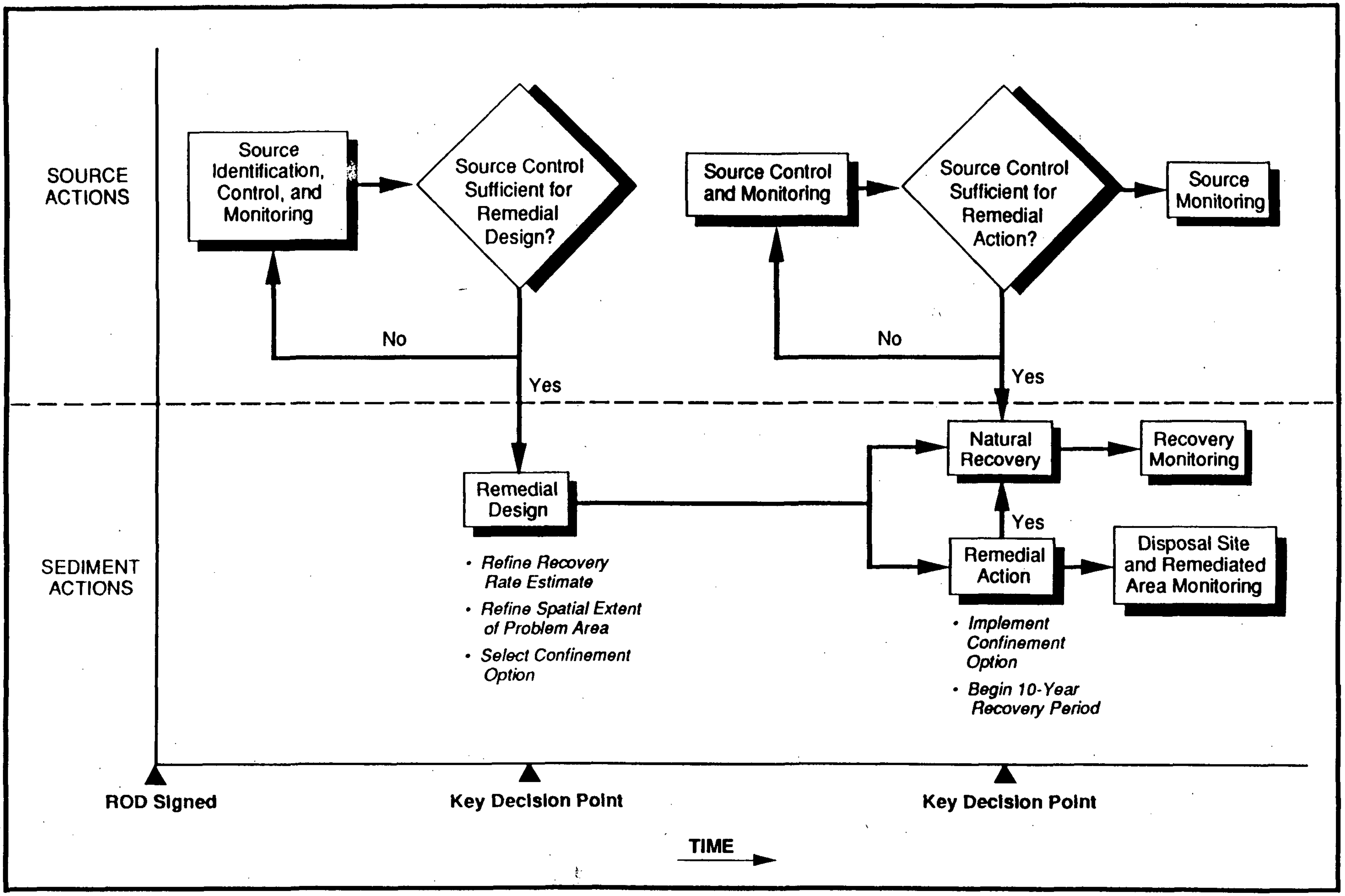


Figure 18. Key decision points and associated activities

in a reasonable timeframe (i.e., 10 years), or whether sediment remedial action is necessary in all or a portion of the problem area. This information will also be used to support the selection of the appropriate confinement option or combination of confinement options if remedial action is determined to be necessary for a particular problem area.

New information on previously unidentified contaminants will also be evaluated during the remedial design phase and integrated into the remedial design sampling and analysis strategy. For example, recent sampling conducted by EPA as a part of a national bioaccumulation study has indicated that dioxin may be present in shellfish in the CB/NT site at levels that pose a potential threat to human health (Appendix B, Section 2.1.6). Preliminary evaluation of this data suggests that further development of source- and sediment-related dioxin data in the Hylebos and St. Paul Waterways is warranted.

Following remedial design, source control and monitoring will continue until Ecology and EPA determine that all major sources have been controlled to the extent that sediment recontamination is not predicted to occur or the source is in compliance with AKARTs. Sediment remedial actions will then be implemented, including sediment monitoring to establish a baseline from which the 10-year recovery period will be evaluated for all areas predicted to recover naturally.

There may be facilities or storm drains which, after implementation of AKARTs, still contribute contaminants at levels that will exceed sediment cleanup objectives in the vicinity of the source. For these facilities, a waiver may be incorporated into applicable permits to allow a temporary sediment impact zone. However, this will not delay or alter implementation of the selected remedy, and sediments within a permitted impact zone will be subject to the same remedy selected in this Record of Decision (i.e., recovery or confinement). Source monitoring will continue under Ecology's source control program. Post-remedial action source monitoring will also ensure that source controls remain effective and that new contaminants are not being introduced.

As part of the sediment cleanup action, EPA will develop and implement monitoring programs for areas that are predicted to recover naturally, areas that have undergone sediment remediation, and for disposal sites. Sediment monitoring will confirm that the selected remedy is effective by 1) tracking the progress of natural recovery, 2) managing permitted sediment impact zones, 3) confirming the effectiveness and integrity of sediment confinement options, and 4) ensuring that source controls remain effective and that new contaminants are not being introduced.

10.4 COSTS

Costs associated with source control activities are not included in this Record of Decision, but may be developed as part of the individual source control actions enforced by Ecology. Because source-related activities are being enforced largely according to existing environmental programs at the federal, state, and local levels, and because the scope of these activities typically goes beyond the identification and control of contaminant loading to the marine environment, it is difficult to determine what proportion of total source-related cost can be attributed to mitigation of contaminated sediments. It is even more difficult to determine the incremental cost of source control that is directly attributable to achieving CB/NT project objectives, relative to achieving compliance with non-CERCLA source control requirements.

Estimated costs associated with sediment-related actions are summarized in Table 12. Revised confined disposal cost assumptions were developed for this Record of Decision, summarized below, and detailed in Appendix D. Costs are modified from the estimates provided in the CB/NT feasibility study based on new information received during and after the public comment period and additional discussions with dredging vendors. Costs associated with confined aquatic disposal are dependent on the sediment volume estimates developed from available sediment data and the natural recovery factors that were incorporated into sediment remedial action cleanup levels to achieve sediment quality objectives within 10 years. Sediment cleanup volume estimates will be refined during the remedial design phase and costs are anticipated to change accordingly.

Costs are also affected by engineering considerations that cannot be fully evaluated until remedial design is completed. The cost estimates presented in Table 12 are based on volume estimates for sediments that are not predicted to recover to the sediment quality objectives in a reasonable timeframe (i.e., 10 years). Other assumptions are:

- The sediment volume to be dredged is composed of a whole number of 4-foot dredging lifts. This assumption incorporates an overdredging allowance.
- Dredged material swells by 75 percent as a result of water entrainment. Upon redeposition, compaction will reduce the volume to an amount only 20 percent greater than the initial volume.
- Excess volume generated by swelling of overdredged sediments at in-waterway confined aquatic disposal sites is disposed of at the PSDDA site. This material is assumed to be clean, as it originates from below the contaminated sediments.
- Sufficient Puyallup River sediment is available to carry out habitat mitigation for the nearshore disposal alternative.
- As a general policy for the CB/NT site, EPA would prefer that the nearshore disposal option only be utilized in conjunction with projects that would otherwise be permitted commercial development. Site preparation costs are to be assumed by the developer and are not included in these estimates. For the purpose of estimating transportation costs, the Blair Waterway slips, which are centrally located, are assumed to be available and of sufficient capacity for at least some projects.

A different assumption regarding the implementation of the confined aquatic disposal option was also incorporated into the revised cost estimates. Implementation of the confined aquatic disposal option was assumed to be onsite, rather than at the offsite location described in the feasibility study. The offsite location was determined to be problematic due to technical considerations (e.g., the depth was 100-200 feet) and because transport of untreated sediments to the facility would be in conflict with the Superfund offsite policy.

11. STATUTORY DETERMINATION

Under CERCLA, EPA's primary responsibility is to undertake remedial actions that assure adequate protection of human health and the environment. In addition, Section 121 of CERCLA established several other statutory requirements and preferences for cleanup. These specify that when complete, the selected remedial action for the site must comply with applicable or relevant and appropriate environmental standards established under federal, state, or tribal environmental laws unless a statutory waiver is justified. The selected remedy must also be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element. The following sections discuss how the selected remedy meets these statutory requirements.

11.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy protects human health and the environment through source control measures that eliminate major sources of contaminants to the marine environment, especially in relation to bottom sediments in each of the eight CB/NT problem areas addressed in this Record of Decision. The remedy also provides for sediment confinement measures that isolate contaminated sediments from sensitive and edible marine resources. Sediment confinement options include *in situ* capping, confined aquatic disposal, nearshore disposal, and upland disposal.

In the CB/NT area, the current risks to public health are associated primarily with consumption of seafood organisms that have accumulated PCBs from contaminated sediments. For baseline conditions evaluated during the remedial investigation, the estimated lifetime risks associated with consumption of 1 pound/month (15 grams/day) of Commencement Bay fish were about 2×10^{-4}. Remediation of sediments containing over 150 μg/kg PCBs should result in fish tissue concentrations similar to those in fish from Carr Inlet, a relatively uncontaminated reference area in Puget Sound. Sediment remediation at this level would reduce the excess lifetime risks associated with PCBs contamination in Commencement Bay fish to about 4×10^{-5} for a seafood consumption rate of 12.3 grams/day, which has recently been identified as an average fish consumption rate for the Puget Sound area. Those individuals who are consuming seafood from the CB/NT site at a greater or lesser rate would experience, respectively, greater or lesser associated risks. This average post-remediation risk level is within the acceptable range of risks (10^{-7} to 10^{-4}) for Superfund sites.

Contamination of CB/NT sediments by a wide variety of organic and inorganic chemicals has been shown to result in substantial adverse effects to biological resources. Effects have been demonstrated using a preponderance-of-evidence approach that incorporated multiple biological indicators of sediment toxicity (sublethal and lethal) and direct effects on benthic infauna and fish communities. Because of the documented impacts to biological resources and potential impacts to human health that are evident in the CB/NT problem areas, there is a presumption of harm and/or an imminent threat posed by contaminants in these areas. In order to be protective of both the public heath and the environment, a sediment quality objective has been established for these areas in which a no adverse effects level was measured by the three biological indicators and human health assessment methods described in this Record of Decision. These biological effects indicators were also used to develop empirical sediment quality values AET that relate measured biological effects to concentrations of chemical contaminants. Validation studies in Puget Sound have demonstrated that AET have a high reliability (86-96 percent) in predicting the presence or absence of adverse biological effects. Therefore, remediation of Commencement Bay sediments to contaminant levels based on AET should ensure that biological conditions would improve to levels characteristic of Puget Sound reference areas, the function of high quality habitat would be restored, and fisheries would be enhanced.

11.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The selected remedy of source control, natural recovery, and sediment confinement (i.e., *in situ* capping and/or onsite disposal) will comply with all action-, chemical-, and location-specific ARARs. The ARARs are presented below.

11.2.1 Action-Specific ARARs

Sediment remedial activities (i.e., capping, dredging, and/or disposal of contaminated sediments) will meet the following action-specific ARARs:

- Requirements for upland disposal of RCRA hazardous waste as established in 40 CFR 246, 264, 265, 268 Subpart D, and 52 CFR 8712
- Washington state Hazardous Waste Management Act (RCW 70.105) requirements for upland disposal of solid waste, dangerous waste, and extremely hazardous waste as codified in WAC 173-303-081 and WAC 173-303-650
- Substantive requirements and guidelines of Clean Water Act Section 404 (40 CFR 125) as implemented by the Corps and EPA (e.g., for dredging and dredged materials management, including designation of disposal sites)
- Requirements of the state water quality certification process pursuant to Clean Water Act Section 401 (40 CFR 125) (i.e., actions must not result in a violation of water quality standards or other state policies, requirements, and laws that pertain to the aquatic environment and beneficial use protection)
- Substantive requirements of the Washington Department of Fisheries and Washington Department of Wildlife hydraulics permit (e.g., design and performance constraints and timing of action)
- Requirements of Washington Model Toxics Control Act (Initiative 97) for managing hazardous waste site cleanups, Chapter 2, Laws of 1989
- Washington Shoreline Management Act requirements for activities conducted within 200 feet of shorelines of statewide significance (RCW 90.58, WAC 173-14)
- Washington state requirements for interference with the natural flow of state waters as set forth in RCW 75-20.100 and WAC 220-110
- The Puyallup Tribe of Indians Settlement Act of 1989 (public law 101-41, 21 June 1989) requiring substantial restoration and enhancement of the fisheries resource in the Commencement Bay area
- Puyallup Tribe Water Quality Program (Puyallup Tribal Council Resolution No. 71288) adopting Washington Water Quality Standards and protecting fishing rights, habitat values, surface water, and groundwater.

Source control activities will meet the following action-specific ARARs:

- Washington state Hazardous Waste Management Act (RCW 70.105) requirements for upland disposal of solid waste, dangerous waste, and extremely hazardous waste as codified in WAC 173-303-081 and WAC 173-303-650
- Requirements of Washington Model Toxics Control Act (Initiative 97) for managing hazardous waste site cleanups, Chapter 2, Laws of 1989
- Requirements for discharges to publicly owned treatment works as established in 40 CFR 403.5, 264.71, and 264.72

- Conditions stated in the pertinent NPDES permits governing direct discharges including storm drain outfall to Commencement Bay waters (40 CFR 125.122, 125.123, 125.124)
- Conditions stated in the pertinent pretreatment permits governing direct discharges to city of Tacoma sanitary sewers
- Puyallup Tribe Water Quality Program (Puyallup Tribal Council Resolution No. 71288) adopting Washington Water Quality Standards and protecting fishing rights, habitat values, surface water, and groundwater
- Washington Water Pollution Control Act (RCW 90.48) requirements governing discharges of any pollutant to waters of the state
- Washington Shoreline Management Act requirements for activities conducted within 200 feet of shorelines of statewide significance (RCW 90.58, WAC 173-14)
- The Puyallup Tribe of Indians Settlement Act of 1989 (public law 101-41, 21 June 1989) requiring substantial restoration and enhancement of the fisheries resource in the Commencement Bay area.

11.2.2 Chemical-Specific ARARs

Sediment remedial activities may be required to meet the following chemical-specific ARARs depending on the activity in question (e.g., dredging, dredged material disposal):

- Limiting permissible concentrations established by 40 CFR 125.120-125.124; 227.22, and ambient water quality criteria for protecting human health and aquatic organisms established by 40 CFR 131
- Groundwater protection requirements for RCRA facilities as established by 40 CFR 264 and 265
- Federal requirements for groundwater used as drinking water as set forth in 40 CFR 141 and 143
- Federal regulations (implemented by 40 CFR 261.24) requiring an extraction procedure toxicity test for contaminant leaching trigger handling and disposal requirements
- Washington water quality standards for surface waters (WAC 173-201)
- Water Pollution Control Act (RCW 90.48) and Water Resources Act (RCW 90.54) require the use of AKARTs for controlling discharges to surface water and groundwater.

The above standards may be exceeded on a short-term, localized basis during dredging or sediment disposal operations due to resuspension of contaminated sediment.

Source control activities will meet the following chemical-specific ARARs:

- Water Pollution Control Act (RCW 90.48) and Water Resources Act (RCW 90.54) require the use of AKARTs for controlling discharges to surface water and groundwater
- Technology-based standards established in Clean Water Act Section 301(b)
- Limiting permissible concentrations for discharges into marine waters pursuant to 40 CFR 125.120-125.124; 227.22
- Ambient water quality criteria for the protection of aquatic life and human health established by 40 CFR 131
- Washington water quality standards for surface water as established by WAC 173-201.

11.2.3 Location-Specific ARARs

Sediment remedial activities will meet the following location-specific ARARs:

- Clean Water Act Sections 404 and 401 (40 CFR 125) substantive requirements for dredged material evaluation and impacts assessment (including wetlands protection)
- Rivers and Harbors Appropriations Act Section 10 substantive requirements for protecting navigable waterways
- Puyallup Tribe Land Claim Settlement requirements for actions that impact fisheries resources in the Puyallup River delta
- Executive Orders 11990 and 11988 (40 CFR 6 Appendix A) to avoid adverse effects, minimize potential harm, and restore and preserve natural and beneficial uses of wetlands and floodplains.

Source control remedial activities will meet the following location-specific ARARs:

- Washington Shoreline Management Act requirements for activities conducted within 200 feet of shorelines of statewide significance (RCW 90.58, WAC 173-14)
- Washington state Hazardous Waste Management Act (RCW 70.105) requirements for upland disposal of solid waste, dangerous waste, and extremely hazardous waste as codified in WAC 173-303-081 and WAC 173-303-650
- Requirements of Washington Model Toxics Control Act (Initiative 97) for managing hazardous waste site cleanups, Chapter 2, Laws of 1989.

11.2.4 Other Factors To Be Considered

Sediment remedial action will consider the following:

- Requirements and guidelines for evaluating dredged material, disposal site management, disposal site monitoring, and data management established by PSDDA (1988)
- Critical toxicity values (acceptable daily intake levels, carcinogenic potency factor) and U.S. Food and Drug Administration action levels (for concentrations of mercury and PCBs in edible seafood tissue)
- Pending TPCHD regulations for sanitary landfills
- Substantive land use requirements of the Tacoma Shoreline Master Program
- *EPA Wetland Action Plan* (U.S. EPA 1989) describing National Wetland Policy and goal of no net loss
- 1989 PSWQA plan (PSWQA 1988) Elements P-2 and P-3 for sediment quality standards and sediment impact zones
- 1989 PSWQA plan (PSWQA 1988) Elements S-4, S-7, and S-8 for confined disposal, cleanup decisions, and investigations and cleanups of contaminated sediment.

Source control actions will consider the following:

- AKART guidelines and 1989 PSWQA plan (PSWQA 1988) Elements P-6 and P-7 for the development of AKART guidelines and effluent limits for toxicants and particulates
- 1989 PSWQA plan (PSWQA 1988) Element P-3 for the development of criteria for defining sediment impact zones relative to discharges.

11.3 COST EFFECTIVENESS

The cost of the selected remedy is described in terms of sediment-related activities only, because source controls are being enforced largely according to non-CERCLA environmental authorities and programs. The net present worth value represented by *in situ* capping for St. Paul Waterway is estimated to be $1,820,000 (actual costs for capping not provided by Simpson Tacoma Kraft Company for this Record of Decision). The cost of implementing the selected remedy in the remaining seven problem areas will vary according to the types of confinement options actually utilized. Because the confined aquatic disposal option can be implemented within each problem area, site availability is less of a limiting factor. It is therefore the most likely option to be implemented on an areawide basis and is the only option for which areawide costs are presented. The net present worth value for implementing confined aquatic disposal in the remaining seven problem areas is estimated to be $30,500,000.

The total estimated cost of sediment-related activities in all eight CB/NT problem areas addressed in this Record of Decision is therefore $32,300,000. Costs associated with *in situ* capping are approximated a factor of 0.5 less, costs associated with nearshore disposal are approximately a factor of 0.8 less, and costs associated with upland disposal are approximately a factor of 2 greater than those associated with confined aquatic disposal. It is expected that the remedy implemented at these problem areas will represent a combination of these confinement options, which would be reflected in actual costs. Revisions in estimates to the cleanup volume based on the results of remedial design sampling are expected to have a major impact on these cost estimates. However, the selected remedy is cost-effective because it has been determined to provide overall effectiveness relative to costs of the other remedies evaluated for sediment remedial action.

Because natural recovery is included as a key element of the overall alternative, the estimated costs of the remedy are approximately one-half of what they would be if the remedy did not incorporate natural recovery over a 10-year time period. The estimated costs of the selected remedy are at least one-tenth of the costs associated with incineration, and at least one-quarter of the costs associated with treatment of sediments by solvent extraction, and at least one-half the costs associated with solidification. These comparisons to treatment costs are derived from feasibility study cost estimates, which are assumed to be valid for comparison purposes.

By providing for flexibility in the disposal site option, the selected remedy provides a cost-effective means of achieving the project objective: acceptable sediment quality in a reasonable timeframe. Nearshore disposal can be integrated into planned construction projects that require fill. Similarly, disposal location siting can take into consideration the unique use requirements of each of the remaining seven problem areas to minimize economic impacts associated with implementation of the selected remedy (e.g., shipping traffic disruption), or associated with projected uses of the waterways.

11.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT/ TECHNOLOGIES

EPA and the state of Washington have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner at the CB/NT site. Of those alternatives that are protective of human heath and the environment and comply with ARARs, EPA and the state have determined that the selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility or volume achieved through treatment; short-term effectiveness; implementability; and cost. The selected remedy also offers the highest degree of overall acceptance by the state, tribe, and affected community.

While the selected remedy does not include treatment (i.e., solvent extraction, solidification, incineration) as a principal element in sediment remedial actions, it will significantly reduce the inherent hazards posed by the contaminated sediments through isolation and source control. The principal threat posed by contaminated sediments is through exposure of resident benthic communities living at or near the sediment-water interface, fish that feed on benthic organisms or live in close association with surface sediments, and humans who consume organisms that have been exposed to the sediments and have accumulated contaminants. Burial of the contaminated sediments, either through natural accumulation of clean sediments, or through confined aquatic disposal, eliminates the potential rates of exposure. Source control ensures that this very sensitive interface will not be recontaminated, and monitoring verifies that source controls and sediment remedial actions have been effective.

11.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

This decision to confine sediment either in-place or in onsite disposal facilities is consistent with program expectations, which focus treatment technologies on more highly toxic, concentrated wastes. In general, sediment contamination at the CB/NT site is characterized by very large volumes of low concentration material. Because contaminant releases to the marine environment have often been slightly dispersed in the water column as they settle, and are further mixed with clean, naturally occurring particles as they accumulate on the bottom, they tend to be relatively dilute as compared to more concentrated waste materials. Furthermore, contaminants that have accumulated in the sediments typically have a strong affinity for particles. Thus, once in place, most sediment contaminants are relatively stationary unless the particles with which they are associated are disturbed and remobilized. The potential for remobilization of particles within a confined disposal facility is relatively remote if the facility is properly designed and engineered.

12. DOCUMENTATION OF SIGNIFICANT CHANGES

The proposed plan for the CB/NT site was released for public comment in February 1989. The proposed plan described the preferred alternatives identified in the feasibility study for the nine problem areas then included in the investigation, and identified a more general performance-based alternative as the preferred alternative. Since that time, the following changes have been made:

1. **Project Scope:** The problem area designated Ruston-Pt. Defiance Shoreline has been established as a separate operable unit for the site: Operable Unit 06 (ASARCO Sediments) (described in greater detail in Section 5.1.6), reducing the number of problem areas addressed in this Record of Decision to eight.
2. **Source Control:** Source control has been established as an operable unit for the site which will be managed according to the objectives described in this Record of Decision.
3. **Habitat Objectives:** The importance of habitat restoration and fisheries enhancement has been clarified as a component of the CB/NT cleanup objective.
4. **Selected Remedy:** A limited range of four confinement options was selected to represent the sediment remedial action element of the selected alternative.
5. **Cost Estimates:** Adjustments to cost estimates were made.
6. **Timeframe for Implementation Schedules:** Planning schedules for overall project implementation were adjusted.

These changes are logical outgrowths of the proposed plan, and are based on new information provided during the public comment period.

12.1 PROJECT SCOPE

The Ruston-Pt. Defiance Shoreline problem area described in the feasibility study has been designated as a separate operable unit. This reduces the number of problem areas addressed in this Record of Decision to eight.

This change in project scope was made because the agencies received a remedial investigation for the ASARCO Tacoma smelter and off-shore sediments as a comment to the CB/NT feasibility study during the public comment period. This report included detailed new information about characteristics, areal extent, and volume of contaminated sediments along the Ruston-Pt. Defiance Shoreline. The agencies have reviewed this information and believe that further detailed analysis of remedial alternatives for this problem area is needed. The new information submitted during the comment period indicates that sediment toxicity problems associated with coarse-grained slag particles unique to the Ruston-Pt. Defiance Shoreline may be less severe than predicted in the CB/NT feasibility study. Therefore, significant changes regarding the estimated volume of contaminated sediments, the preferred sediment remedial alternative, and the cost of this remedy can be anticipated. The information is specific to the Ruston-Pt. Defiance Shoreline sediments, and does not alter the selection of remedy for the other eight problem areas.

Once the agencies have fully evaluated the feasible remedial alternatives for this problem area, EPA and Ecology will issue a new proposed plan for a 30-day public comment period. After consideration of public comments, the agencies will select a remedy for the operable unit and issue another Record of Decision specific to the CB/NT Ruston-Pt. Defiance Shoreline problem area.

12.2 SOURCE CONTROL

Source control has been described previously as the most challenging and critical first step in the overall response strategy for the CB/NT site (Section 5.1). Ecology's Commencement Bay UBAT was established in response to that challenge and is currently undergoing an expansion as a result of additional resources made available through a Superfund cooperative agreement. To more effectively manage that cooperative agreement and source control as a key element in the selected remedy, Operable Unit 05 (Source Control) was established in the spring of 1989. Public comment received on the CB/NT feasibility study indicated a very broad-based consensus that enhanced source control measures were important to overall project success.

12.3 HABITAT OBJECTIVES

The role of habitat function as an important component of the overall project objectives was expanded and clarified in response to three related issues presented during the public comment period. First, concerns were raised that dredging activities could compromise important habitat, particularly in intertidal environments. Second, various comments were received indicating that impacts affecting habitat function should be evaluated in relation to impacts associated with contamination problems. Third, the Puyallup Tribe of Indians Settlement Act of 1989 was promulgated, requiring substantive protection and enhancement of fisheries resources in the Commencement Bay area. The habitat restoration protocols being developed by EPA's Region 10 Wetlands Program and Puget Sound Estuary Program will be incorporated into habitat evaluation in the CB/NT problem areas before and after sediment remedial action at both dredging and disposal sites. These protocols are being designed to quantitatively assess those characteristics of an area that contribute to habitat function (i.e., feeding, refuge, and reproduction). Habitat function has been included conceptually as a remedial objective that will be addressed in sediment remedial design.

12.4 SELECTED REMEDY

In the proposed plan for the feasibility study, the agencies recommended that a performance-based remedy that could incorporate multiple sediment remedial options would be preferable to one that limited remedial action to a single specific technology. The recommendation was based on evaluations in the feasibility study indicating that all four confinement options offered similarly feasible and cost-effective means of achieving the project cleanup objectives.

However, in the CB/NT feasibility study, a preferred remedy was identified for each problem area which included a specific confinement option (e.g., nearshore disposal was preferred for the Head of Hylebos Waterway). The decision to define a generalized confinement element for sediment remediation instead of the specific confinement options identified in the feasibility study or a performance-based remedy as recommended in the feasibility study was based on comments received during the public comment period, and additional technical and administrative review conducted by EPA and Ecology. This decision affects only the sediment remedial action element of the remedy. Source control and natural recovery remain key elements of each problem area remedy.

The preferred alternative identified in the CB/NT feasibility study and the selected remedy described in Section 10 are summarized in Table 15. The remedy selected for the St. Paul Waterway problem area represents one of the four confinement options: *in situ* capping. For the Mouth of Hylebos, Head of City, and Wheeler-Osgood problem areas, open-water confined aquatic disposal was identified as the preferred alternative in the feasibility study. Nearshore disposal was identified in the feasibility study as the preferred alternative for Head of Hylebos, Sitcum and Middle problem areas. Institutional control (including natural recovery) was selected as the preferred alternative for the Mouth of City Waterway problem area.

TABLE 15. SEDIMENT REMEDIES SELECTED IN THE FEASIBILITY STUDY AND RECORD OF DECISION

Problem Area	Feasibility Study	Record of Decision
Head of Hylebos	Nearshore disposal	Confined disposal[a]
Mouth of Hylebos	Confined aquatic disposal	Confined disposal[a]
Sitcum	Nearshore disposal	Confined disposal[a]
St. Paul	*In situ* capping	*In situ* capping
Middle	Nearshore disposal	Confined disposal[a]
Head of City	Confined aquatic disposal	Confined disposal[a]
Wheeler-Osgood	Confined aquatic disposal	Confined disposal[a]
Mouth of City[b]	Institutional controls	Confined disposal[a]

[a] *In situ* capping, confined aquatic disposal, nearshore disposal, upland disposal.

[b] Predicted to recover following source controls.

After consideration of public comment, a limited range of confinement options was determined to offer the most appropriate means of achieving the project cleanup objectives in a timely manner. The four different confinement options provide comparable protection of human health and the environment, and they are similarly comparable when evaluated by the balancing criteria. Variations in long- and short-term effectiveness and permanence are relatively minor and are given less weight than if the waste were higher in contaminant concentration. This added flexibility also addresses cost concerns. For example, it is recognized that the added costs associated with upland disposal may be justified for selected areas where *in situ* capping, nearshore disposal, or confined aquatic disposal could interfere with commercial and navigational activities. In addition, new information collected during remedial design sediment sampling could greatly influence the selection of the specific confinement option. It is anticipated that the spatial extent of contamination exceeding sediment quality objectives and the areal extent of sediment predicted to recover naturally could change significantly based on more detailed information on the distribution of contamination concentrations, site-specific biological test results, refined sedimentation rates, improved information on source loading rates, and new information on chemical degradation and loss rates. Changes in waste volume will significantly impact the capacity requirements of disposal sites and consequently influence the overall disposal site design.

12.5 COST ESTIMATES

Comments received during the public comment period suggested that costs associated with candidate alternatives were underestimated. Subsequent review of the costing procedures indicated that unit dredging costs were underestimated by approximately a factor of 2, and that bulking factors due to incorporation of water during dredging were not included. The costs developed in the CB/NT feasibility study were used to analyze the costs of the treatment alternatives relative to the costs of confinement alternatives. New costs were developed for the four confinement options using more realistic estimates for unit dredging costs and bulking during dredging. Other cost refinements were also developed on the basis of revisions to the preferred alternatives and changes in assumptions regarding the factors that would influence their implementation. For example, nearshore disposal cost estimates do not include site development because it has been determined that this alternative will only be implemented when integrated into nearshore construction projects. The cost estimates developed for the Record of Decision for confined aquatic disposal assume that overdredging techniques will be used.

12.6 IMPLEMENTATION SCHEDULES

The implementation schedules for both source control and sediment remediation as described in the CB/NT integrated action plan (PTI 1988) have been revised in response to public comment. Many comments indicated that the estimated schedules appeared to be based on unrealistically short timeframes for source control. The schedules have been re-evaluated by EPA and Ecology for each of the CB/NT problem areas. In general, the schedules were revised to include 1-3 more years of source control activities. The schedule revisions have been adjusted to reflect additional time needed to investigate and address CB/NT sources, including storm drains, that were not factored into the integrated action plan schedules. The overall timeframe for the action cleanup phase of the project has therefore been adjusted from 4 years to a total of 8 years, as reflected in the planning schedules in Appendix C.

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APPENDIX A

Letters of Concurrence

CHRISTINE O. GREGOIRE
Director

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Mail Stop PV-11 • Olympia, Washington 98504-8711 • (206) 459-6000

September 27, 1989

Mr. Robie Russell
Regional Administrator
EPA Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Dear Mr. Russell:

The Washington Department of Ecology has completed its review of the Record of Decision (ROD) for the Commencement Bay Nearshore/Tideflats project. Based on this review, the State concurs with the selected remedy.

I am glad the ROD includes a range of options for sediment disposal. EPA's willingness to work with Ecology and the Puyallup Tribe in refining a list of Applicable or Relevant and Appropriate Requirements (ARAR's) is an excellent step in ensuring that the cleanup will meet the requirements of federal, state, and tribal laws. Also, we look forward to further clarifying the process for determining when sources have been controlled sufficiently to allow sediment cleanup to proceed.

I appreciate the long hours both EPA and Ecology staff have contributed to complete the ROD on schedule. We look forward to working with EPA, the Tribe, the environmental community, and Commencement Bay responsible parties in the upcoming phases of source control and sediment remediation.

Sincerely,

Christine O. Gregoire

Christine O. Gregoire
Director

COG:kmk

cc: Mike Gallagher
Carol Fleskes
Rich Hibbard
Terry Husseman
Bill Sullivan-Puyallup Tribe
Mike Wilson-SWRO

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SEP 29 1989

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September 29, 1989

Mr. Robie G. Russell
Regional Administrator
U.S. Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, Washington 98101

HAND-DELIVERED

RE: Tribal Concurrence on Commencement Bay Final Record of Decision

Dear Mr. Russell:

This letter is written on behalf of the Puyallup Tribe of Indians with regard to the letter you received from Chairman Henry John regarding the above-referenced matter on September 26, 1989. Based upon subsequent conversations among Tribal and EPA representatives, the issue arose concerning the status of the Tribe's "conditional concurrence" as set forth in Chairman John's letter of September 26, 1989. Please be advised that the Puyallup Tribe of Indians has concurred with the selection of remedy as set forth in the final draft record of decision ("ROD") for the Commencement Bay Superfund site.

Please be further advised that the Tribe reserves the right to fully participate in selection of the alternative to be implemented by EPA on a site specific basis. The Tribe also agrees with EPA that there is indeed a need for further testing and analysis to fully determine the remedy to be implemented in a manner consistent with the Superfund law.

It is understood between the Tribe and EPA that the list of concerns and conditions set forth in Chairman John's September 26th letter continue to be concerns of the Tribe with regard to the implementation phase of the selected remedy. Accordingly, the Tribe wishes to fully participate with EPA and the State of Washington as one of the three sovereign governments implementing and enforcing the selected remedy at the Commencement Bay/Nearshore Tideflats Superfund Site. Such actions on a part of the Tribe would include participation in remedial design, source control, and those studies and activities relevant to the protection of fishery habitat and fishery resources of the Puyallup River Basin Commencement Bay area.

It has been the consistent and vigorous position of the Puyallup Tribe that the fishery resources of Commencement Bay be protected and that measures be taken to implement the ROD consistent with the need to protect such treaty protected fishery resources. The Puyallup Tribe appreciates EPA's acknowledgement of the settlement legislation, settlement agreement and technical appendices as component parts of the clean up standards or ARARs, and looks forward to working with EPA in the implementation phase of the remedial action.

As previously discussed with the Superfund Site Manager and EPA Office of Regional Counsel, it is critical that EPA make additional resources available to the Tribe so that the Tribe may meaningfully participate in the remedial design and remedy implementation stages of the clean up. Our Superfund agreement may serve as a foundation upon which to base a fuller measure of federal support for the Tribe's participation and we look forward to initiating discussions with you in this regard.

On behalf of the Tribal Council, I again want to express appreciation for the hard work of the EPA Region X staff, and we look forward to a continuing government-to-government relationship directed to protection of the fishery and treaty resources of the Puyallup Tribe and the people of the State of Washington.

Sincerely,

THE Du BEY LAW FIRM

RICHARD A. Du BEY
Special Environmental Counsel
Puyallup Tribe of Indians

RAD:rb
cc: Henry John, Chairman, Tribal Council
Rolleen Hargrove, Vice-Chair, Tribal Council
Gabe Landry, Councilmember
Nancy Shippentower, Councilmember
Herman Dillon, Jr., Councilmember
Bill Sullivan, Director, Environmental Programs
John Bell, Reservation Attorney
R. Randall Harrison, Office of Reservation Attorney
Mike Stoner, EPA, Superfund Site Manager
Allan Bakalian, EPA, Assistant Regional Counsel

File No. 8834.1
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generated by the study and included in the evaluation of that data. The selected remedy must be revised to deal with the presence of any dioxins demonstrated by the study.

One clarification and one correction need to be made to the list of ARARs on page 90 of the ROD. The Puyallup Tribe of Indians Settlement Act is noted as an ARAR applicable to "Puyallup Tribe lands." The clarification is as follows:

> The specific standards for protection of the environment which are adopted as an ARAR are found in the Agreement negotiated by the parties to the Settlement. The Settlement Act mentioned on page 90 incorporates and adopts that Agreement. We want to be sure that people are not confused when they read the Act and do not see the specific environmental standards. They are found in the Agreement.

The correction is as follows:

> The environmental standards in the Settlement Agreement are applicable to a much wider area than "Puyallup Tribe lands," if that phrase is interpreted to mean parcels of land owned by the Tribe. A shorthand means of referring to the location to which this ARAR is applicable would be "Commencement Bay/Puyallup River watershed."

The Tribe's conditional concurrence expressed in this letter does not in any way address or limit the Tribe's right to pursue and collect damages or other relief against potentially responsible parties under applicable law for harm caused to natural resources by those parties.

The Tribe's conditional concurrence expressed in this letter also does not in any way address or limit any action the Tribe may take in the future to protect and enforce its treaty-reserved fishing rights including protection of the fisheries habitat.

The Tribe's conditional concurrence expressed in this letter also does not in any way limit or bind the Tribe in discussions that are taking place and agreements that we anticipate with the Port of Tacoma concerning certain property that is to be transferred to the Tribe as part of the Settlement Agreement.

Please do not hesitate to contact our staff if discussion or clarification of any of these issues would be helpful.

Sincerely,

Henry John

Henry John
Chairman, Puyallup Tribal Council

CC: Tribal Council
Bill Sullivan
Law Office
Richard Hibbard, DOE
Mike Stoner, EPA
Richard DuBey

Puyallup Tribe of Indians

September 26, 1989

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SUPERFUND BRANCH

Mr. Robie G. Russell
Regional Administrator
U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, WA 98101

Re: Commencement Bay Final Draft Record of Decision

Dear Mr. Russell:

The Puyallup Tribe of Indians has reviewed the final draft Record of Decision for the Commencement Bay Nearshore/Tideflats. This document is critically important to the health and well-being of members of the Puyallup Tribe. We appreciate very much the work that has gone into the document and as well as your recognition that the Tribe has a critical role in the process of directing the cleanup of Commencement Bay.

The Puyallup Tribal Council, governing body of the Tribe, has instructed me to communicate to you the Tribe's position on the final draft ROD. Although EPA has responded to many of the issues raised in the Tribe's earlier comments, we are still not convinced that the selected remedy will fully protect, among other things, human health and the fisheries habitat. We do agree, however, with the general purposes and goals stated in the ROD, and with many aspects of the selected remedy. The Tribe therefore gives its <u>conditional concurrence</u> to the selection of remedy in the ROD.

The Tribe's concurrence is conditioned on several factors which I will spell out. If any of those conditions are not met or satisfactorily accomplished within reasonable time limits in the planning or implementation of the remediation process, then the Tribe's response should be changed to reflect that the Tribe does not concur in the final draft ROD.

Another reason the Tribe makes its concurrence conditional is that many parts of the analysis and the proposed remedy are still undefined. Thus, if additional data is generated during the process, the Tribe reserves the right to add to and elaborate upon the conditions of its concurrence.

The Tribe agrees with the remedy selected in the ROD as long as certain conditions are met. Those conditions consist of the

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items identified in the Tribe's letter of June 24, 1989 (addressed to Mr. Michael Stoner of EPA and Mr. Richard Hibbard of the Washington Department of Ecology), commenting on the draft feasibility study that led to this ROD. (A copy of the June 24 letter is attached to this letter.) Although some of the problems identified by the Tribe's comments have been satisfactorily addressed in the ROD, others have not. Even in cases where the ROD has been modified to address the Tribe's concerns, there are some situations where we do not know whether the remedy selected will be satisfactory until more information is available or until we see the results of the remedial action. The Tribe therefore conditions its concurrence on compliance with all of the elements listed in the Tribe's prior comments.

The following list is a summary of the general concerns that remain, and the categories into which the conditions on the Tribe's concurrence fall. This is not an exhaustive list of the conditions on the Tribe's concurrence; see the Tribe's letter of June 24, 1989, for a more complete and detailed list.

1. The selected remedy must protect human health and the environment.

2. The cumulative health risks from all dangerous chemicals, including their synergistic effects, must be assessed and remedied.

3. The tribal ARARs must be met to protect human health, the environment, and tribal resources, including the Tribe's federally-guaranteed treaty rights.

4. The selected remedy must be a permanent solution to the existing problems.

5. The Tribe must continue to have a meaningful role in decision-making concerning the development of source control measures, design of remedial actions, and natural resource restoration.

6. The Agency of Toxic Substance and Disease Registry is in the process of revising its earlier study in order to determine whether there is a causal relationship between the bioaccumulation of hazardous substances and the alarming cancer rate among tribal members. EPA must reevaluate the remedy selected in the ROD in light of the results of that revised study.

7. There must be a more thorough study to test for the presence of dioxins. The Tribe must be provided with the data

APPENDIX B

Responsiveness Summary

CONTENTS

RESPONSIVENESS SUMMARY

I. OVERVIEW

The purpose of this document is to summarize and respond to the public comments submitted in regard to the proposed plan and other alternatives for cleanup of the Commence Bay Nearshore/Tideflats (CB/NT) site. It addresses comments for the eight problem areas covered in this Record of Decision. This Responsiveness Summary is required in Section 117 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

The Washington Department of Ecology (Ecology) and U.S. Environmental Protection Agency (EPA) identified a preferred alternative for the CB/NT site in the feasibility study and proposed plan which were made available for public review and comment from 24 February 1989 to 24 June 1989. The agencies' preferred alternative addressed contaminated marine sediments in nine problem areas identified in the feasibility study. The agencies recommended selecting a combination of source control, natural recovery, and active remediation of those sediments in the problem areas that would not recover naturally to the sediment quality objective within 10 years. The agencies further recommended that the selected sediment remedial alternative (for areas requiring active remediation) be performance-based, rather than selecting a single specific remedy, as long as the technology chosen satisfied the performance criteria, as well as all CERCLA requirements.

The agencies have carefully considered all comments submitted during the public comment period. Based on comments received during the public comment period, members of the community are generally supportive of the overall approach that combines source control, sediment recovery, and sediment remediation, if necessary. Most commenters agreed that there are demonstrable adverse environmental impacts associated with the CB/NT sediments, that the area should support multiple uses (e.g., commercial, recreational), and that control of sources should be a high priority.

Commenters expressed divergent opinions on a number of key issues. These issues included the risks posed by the site, the proposed cleanup goals, the feasibility of and timeframe for source control, and the protectiveness and proposed role of natural recovery as a component of the remedy. Those who are not potentially responsible parties (PRPs) tended to be concerned that the cleanup objectives do not address all impacts and are not protective enough, and that the preferred alternative, particularly the natural recovery component, is neither protective nor permanent. PRPs commented in detail that the cleanup objective is too stringent, that significant health effects have not been demonstrated, that natural recovery should play a larger role, and that active remediation is warranted only in severely impacted areas. These divergent comments have been considered in the selection of remedy and responded to in Section III of this Responsiveness Summary.

The selected remedy, described in the CB/NT Record of Decision, has been modified from the proposed plan in response to comments. The changes, discussed in Section III of this Responsiveness Summary and in Section 12 of the Record of Decision, included:

- Postponing the selection of remedy for sediments in the Ruston-Pt. Defiance Shoreline problem area until further analysis of the detailed comments and new information about this area can be completed, and a new proposal presented to the public
- Establishing source control as an operable unit to be guided by this Record of Decision

- Enhancing and clarifying the role of habitat restoration and fisheries enhancement as a component of the CB/NT cleanup objective
- Selecting a range of containment options as the sediment remedial alternative rather than specifying a performance-based remedy or a single containment alternative
- Revising the cost estimates
- Lengthening the estimated time to achieve sufficient source control.

STRUCTURE

Section II briefly describes the history of community involvement in the CB/NT Superfund project from 1981 to the present (September 1989). It includes a very brief summary of key issues raised by members of the community during that time and a similarly brief discussion of how the agencies have responded to those concerns to date. A list of the community relations activities conducted at the site throughout the project is attached at the end of the Responsiveness Summary.

Section III is a summary of comments submitted during the public comment period which were germane to the selection of the remedy, and EPA's response to those comments. The comments and responses have been categorized by relevant topics and numbered.

Section IV is a very brief summary of remaining issues and concerns, and how they will be addressed during monitoring, remedial design, or remedial action. Comments submitted by ASARCO that are specifically concerned with the toxicity characteristics, and the area, extent, and volume of contaminated sediments off the Ruston-Pt. Defiance Shoreline have been deferred to the Operable Unit 06. A revised feasibility study for that problem area is currently being prepared and will be released for further public review and comment.

Section V is an annotated bibliography that has been developed to help EPA organize and respond to the large volume of comments submitted. It will also assist commenters in tracking between their original comment language and the responses provided in this appendix.

SCOPE OF RESPONSE TO COMMENTS

This Responsiveness Summary addresses the significant comments affecting selection of remedy (pro and con). It does not address many less significant comments that were nonetheless considered, or comments not germane to the remedy selection.

II. COMMUNITY INVOLVEMENT

Local concern about environmental issues focused on contamination of the marine environment in 1980-81. In 1980, the National Oceanic and Atmospheric Administration (NOAA) released a study that indicated elevated concentrations of organic compounds and metal contaminants in Commencement Bay sediments, fish, and shellfish. As a result, in January 1981, the Tacoma-Pierce County Health Department (TPCHD) issued a warning recommending the public not regularly consume the resident bottomfish or shellfish from the Hylebos, Blair, or Sitcum waterways.

In April 1981, approximately 120 persons attended a meeting called by federal, state, and local officials to explain what the government had done, was doing, and was about to do with environmental and public health problems in the Commencement Bay area. A cross section of interests were represented at the meeting, including the Puyallup Tribe of Indians, local business and industries, the Tahoma Audubon Society and the Washington Environmental Council, and individual citizens with no apparent affiliation. The later three groups were the most active participants, stressing their indignation that not enough was being done to correct the problems.

On 23 October 1981, EPA announced a list of 115 hazardous waste sites targeted for action under the new Superfund law. Commencement Bay was included on the list as the top priority site in the state of Washington at that time. That announcement strengthened the public perception that the site had serious hazardous waste problems and resulted in increased public pressure on the agencies to take action. Area residents continued to complain that not enough was done to correct the problems.

In 1981, the agencies committed themselves to making information about the agency activities and the hazards presented by contamination in Commencement Bay timely and accurate and available to all interested paries. The agencies interviewed a range of interested community members in 1983 to determine community concerns, and to plan community relations activities and opportunities for public involvement. The agencies interviewed about 30 more interested persons in 1987 to update their knowledge of community interest and concerns and to revise the community relations plan.

The most interested groups, on a continuing basis, have been local officials, the Puyallup Tribe of Indians, local businesses, local environmental and citizens groups, and other federal, state, and local agencies with an interest in this project. The most consistent community involvement has been in the form of a Citizens Advisory Committee and a Technical Oversight Committee.

The Citizens Advisory Committee was organized by TPCHD in September 1983. The Citizens Advisory Committee was originally established as a specific group of citizens from Tacoma, Vashon Island, and Pierce County, each of whom represented an organized citizen group or geographic constituency. Membership has been limited to 12-16 volunteers interested in following the agencies' progress and serving as a conduit for community interests in the investigation of Commencement Bay. Members of the committee have met regularly with agency representatives for 6 years to help provide a community and individual citizen's perspective of the process. Agency representatives have attended meetings at the request of the Citizens Advisory Committee, providing and receiving information and responding to questions. The Citizens Advisory Committee organized a citizens workshop in April 1989, to discuss and comment on the proposed plan.

Ecology and EPA established a Technical Oversight Committee during the remedial investigation to serve as a scientific and technical review panel for the project and to encourage the participation of interested local, state, and federal agencies. The Technical Oversight Committee was established in recognition of the existence of many other ongoing and related studies and overlapping environmental authorities. In addition to representatives from federal, state, and local agencies, representatives from the Puyallup Tribe of Indians, Port of Tacoma, city of Tacoma, and several local industries also served on the committee and regularly attended meetings. The Technical Oversight Committee met on an as-needed basis with at least one meeting every 3 months through the spring of 1988. The remedial investigation, risk assessment, and some preliminary feasibility study reports were reviewed by the Technical Oversight Committee prior to their release. The draft feasibility study was provided to all Technical Oversight Committee members at the beginning of the public comment period in February 1989.

More than 700 individuals and businesses have requested information about the site and have been included on the agencies' mailing list. The agencies have mailed periodic updates and fact sheets on Superfund projects in the Tacoma area to those on the mailing list. Site-specific fact sheets describing source control, interim remedial actions, the results of the remedial investigation, the draft feasibility study, and proposed plan have been distributed. Ecology and EPA representatives attended many meetings of interested citizens, industry, PRPs, and local government leaders to discuss significant milestones and cleanup action alternatives.

Much of the visible community involvement has centered on specific project developments within the overall scope of the CB/NT site, such as individual source control activities, and the ASARCO smelter. ASARCO-related concerns have consistently drawn considerable interest and involvement. Many members of the community have spoken out in favor of environmental protection in coexistence with a health economy. For example, in late 1987, a large number of environmental groups, community organizations, and citizens spoke out in favor of cleanup of the tideflats and restoration of the environment when the Simpson Tacoma Kraft Company took early action to remediate the tideflats area around the Simpson plant. Local residents are actively involved in ongoing discussions about the proper use and regulation of a municipal incinerator located in the tideflats.

THE PUBLIC COMMENT PERIOD

Media and community interest in the CB/NT site increased as the feasibility study neared completion, focusing on the costs, benefits, and other considerations of cleanup. At the request of several parties, the agencies provided for a 120-day public comment period. The agencies held two formal public meetings and the site managers met with over 20 interest groups. The public meeting transcripts are in the Administrative Record. The Citizens Advisory Committee attracted approximately 50 people to a citizens workshop designed to inform community members about these projects. During the public comment period, EPA and Ecology established an information booth at the Tacoma Fire Department Fireboat Station. Agency representatives were available at the booth 1 day per week to answer questions from members of the community. During this period, the print, radio, and television media all increased their coverage of the issues.

FUTURE COMMUNITY RELATIONS PLANS

In recognition of the scope and complexity of the CB/NT site, EPA is establishing a Technical Discussion Group for the remedial design and remedial action phase in recognition of the scope and complexity of the CB/NT site, and to integrate and expand the information exchange functions of the Technical Oversight Committee and Citizens Advisory Committee. Membership of the Technical Discussion Group is therefore intended to include the CB/NT site management team, representatives of regulatory agencies and programs, PRPs, local government, interested citizens, and organized citizens groups. The purpose of the Technical Discussion Group is to provide a forum for the general review of technical and planning issues during the cleanup phase of the project. Discussion topics may include a wide range of issues related to project status, planning, sediment management and habitat concerns, health issues, local development, and others. It is hoped that the Technical Discussion Group will provide EPA with valuable insight into issues of concern, and thereby contribute to project direction and findings. However, group input will not form EPA policy or determine EPA's course of action, nor will it preclude the 30-day public comment period required upon completion of negotiated agreements between EPA and PRPs for sediment cleanup in each of the problem areas. Meetings will be scientific and technical in nature; legal matters will not be discussed.

CONCERNS RAISED DURING THE INVESTIGATION PHASE OF THE PROJECT

Several major concerns were expressed by residents of the local community during the course of the project. These concerns are briefly summarized below, followed by summaries of the agency's response(s):

Residents questioned how reports of releases or ongoing discharges were addressed.

Response: Ecology's Commencement Bay Urban Action Team (UBAT) and TPCDH's Marine Resource Protection program have responded to reported spills and discharges and ordered cleanup or other actions as appropriate. Some problems were addressed by other Ecology and EPA regulatory authorities. Work on controlling releases and ongoing discharges is a continuing activity because the site is complex, with numerous potential sources. Source control activities will be increased during the active cleanup phase of the project due to additional funding of the Commencement Bay UBAT through a Superfund Cooperative Agreement.

Source control programs at a variety of facilities are already underway. For example, the Simpson Tacoma Kraft source control program has removed more than a million pounds of pollutants from the facility on an annual basis. Other elements of the source control program include chip containment and control of facilities and collection and secondary treatment of all stormwater before discharge through the new plant outfall. To address concerns over municipal storm drain discharges, the city of Tacoma has initiated a program to identify and remove existing sources of contamination, and is also studying the feasibility of treating storm runoff entering the head of City Waterway. Best management practices have been implemented at various facilities to control spillage of materials containing contaminants into the waterways. Other programs have, for example, concentrated on investigation, containment, removal, or treatment of historical wastes located on lands adjacent to the waterways.

Residents asked what potential health problems are caused by groundwater, soil, and sediment contamination, and what potential health problems might result from the consumption of contaminated fish and shellfish. Information was requested on the effects of Commencement Bay pollution on environmental quality and recreational values of Puget Sound, including protection and recovery of bottomfish and shellfish resources.

Response: The agencies developed the Superfund studies to define the nature and extent of contamination, the risks from contamination, and possible solutions. According to the risk assessment, most of the health risks are based on long-term consumption of large quantities of seafood. To reduce those risks and reduce harm to the environment, the agencies worked to control or eliminate ongoing sources of pollution. TPCHD issued a fishing advisory and posted warning signs to discourage fishing in contaminated areas. Federal agencies studied seafood consumption in Commencement Bay and Puget Sound, helping the agencies to better understand and protect populations at risk. The Puget Sound Estuary Program has monitoring and restoration protocols that will be followed during remediation to ensure that the remedial activities result in enhancement of fishery resources.

Residents stressed the need for communication of potential seafood contamination dangers to residents with differences in language or cultural backgrounds.

Response: TPCHD posted warning signs and notices in several languages along the waterways and shorelines to try to discourage fishing and heavy seafood consumption by residents with differing language or cultural backgrounds.

Residents expressed concern about possible job loss and economic effects on residents, the Port and city of Tacoma, tideflats business, and others. Concerns included potential adverse publicity about Tacoma's pollution problems which may drive potential new businesses from the area.

Response: In recognition of the potential adverse economic impacts of a rigid cleanup strategy, the agencies have recommended and now selected a remedy that provides maximum flexibility during implementation while still achieving the project cleanup objectives in a timely manner. The agencies must carry out their statutory mandates to protect public health and the environment. Economic concerns are therefore of secondary importance in the selection of remedy, although the agencies consider cost effectiveness when deciding among equally protective remedies. In the selected remedy, the agencies ensured protectiveness and then built in flexibility by allowing a choice between four different confinement options if sediment remedial action is necessary. This choice will be guided by technical and economic considerations, involving the port, the city, businesses, and the entire affected community.

Environmental protection, cleanup and restoration should yield long-term benefits for business as well as benefits to people and the environment. As the Tacoma News Tribune stated following the public comment period, cleanup should result in the enhancement of Tacoma's reputation as a progressive city, and promote economic growth.

Residents have consistently been concerned about public involvement in Superfund decisions and receiving timely and accurate information about area Superfund activities.

Response: The agencies have responded to this concern by working with interested citizens, including the Citizens Advisory Committee (composed of citizen volunteers and representative of organized citizens groups), publishing periodic and site-specific fact sheets, releasing significant information to the press, maintaining 16 information repositories, and holding a 120-day comment period on the proposed plan. The agencies also plan a continuing effort to facilitate information exchange between the agencies, PRPs, organized citizens groups, and citizens at large in the general review of technical and planning issues during the cleanup phase of the project (see Future Community Relations in this section).

Some residents have questioned the effectiveness of the agencies involved with the investigation and site cleanup actions, as well as the degree and effectiveness of cooperation and consistency among agencies.

Response: The agencies recognize this concern and agree that this has been a problem at times. However, the agencies believe that the proposed plan and selected remedy reflect an awareness and consideration of the opinions and concerns of the affected community, and local, state, and federal agencies. The complex, unique, and precedent-setting nature of the site has required extensive involvement, cooperation, and commitment on the part of the agencies. The Commencement Bay UBAT, Marine Resource Protection, and storm drain programs developed in response to the site are three examples of these efforts. Interagency cooperation through the Technical Oversight Committee has enabled scientific and technical review of work products. Project management support has been facilitated through the Superfund Cooperative Agreements with Ecology and the Puyallup Tribe of Indians.

Some citizens raised questions about ash and potential air emission from a proposed incinerator in the tideflats.

Response: TPCHD has monitored existing incinerator emissions and determined that they are not harmful. Future emissions have been modeled, and so long as proper procedures are followed, it is believed the emissions will continue to be safe. The health department is the appropriate agency to address these concerns.

III. RESPONSE TO COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD

Section III is a summary of the agencies response to comments submitted during the public comment period which were germane to the selection of the remedy. The comment period was held from 24 February to 24 June 1989. The comments and responses have been categorized by relevant topics and numbered. Section IV is a summary of comments that have not yet been fully responded to and a discussion of how they will be addressed during monitoring, remedial design, or remedial action.

Since such a large volume of comments was submitted, Section V has been included as an annotated bibliography. This section was prepared to assist commenters in tracking between their original comment language and the responses in this section.

1. PROGRAM ISSUES

Program-related comments questioned the suitability of the cleanup goal and the 10-year recovery timeframe, and the role of evolving state policy concerning sediment contamination. Comments were received from the Puget Sound Water Quality Authority (PSWQA), U.S. Army Corps of Engineers, Washington Department of Natural Resources, the Puyallup Tribe of Indians, and several private citizens. Comments generally addressed adherence to existing policies (e.g., no net loss of wetlands), programs [e.g., Puget Sound Dredged Disposal Analysis (PSDDA)], laws (e.g., CERCLA), and treaties.

1.1. Comments Related to CERCLA Requirements

1.1.1. The failure to consider alternatives for permanent treatment of wastes is contrary to Superfund regulations (CERCLA). The preferred alternatives in the feasibility study do not represent permanent solutions.

Response: CERCLA specifies a preference for permanent treatment as a principal component of the selected remedy. However, EPA guidance indicates that this preference is appropriate for wastes that are highly concentrated, toxic, and involve relatively mobile contaminants. In contrast, contaminated sediments at the CB/NT site, while toxic, involve very large volumes of relatively low concentration wastes with relatively high particle affinity (i.e., low mobility). Confinement alternatives thus offer the most cost-effective means of achieving a permanent solution at the CB/NT site.

1.1.2. The goal of "no acute or chronic adverse effects" on marine organisms is not required by any applicable law and should not be adopted as the goal for cleanup.

Response: Under CERCLA, the degree of cleanup is often set by applicable laws. However, when no applicable promulgated standards or requirements exist, cleanup levels must be developed utilizing other appropriate guidance and risk assessment methods. Since no promulgated criteria exist for sediment quality, the goals of the PSWQA plan provide important guidance on establishing CB/NT cleanup goals. Element P-2 of the plan requires Ecology to develop and adopt standards for long-term sediment quality in Puget Sound that will help prevent acute and chronic adverse effects on biological resources and significant health risks to humans.

1.1.3. The feasibility study has failed to comply with the National Contingency Plan. For example, the study is too broad (comprising the entire bay) and is based upon inadequate data for any given segment of the bay.

Response: Throughout the CB/NT Superfund project, EPA has followed the regulatory provisions contained in the National Contingency Plan (NCP). The NCP requires a remedial investigation/feasibility study prior to making cleanup decisions to gather enough data to characterize the nature and extent of contamination, and to evaluate alternative remedies for problem areas. The remedial investigation/feasibility study for the CB/NT site, therefore, began by examining the entire bay. In later phases of the study, nine specific problem areas were defined, and remedial alternatives were examined for each problem area. The remedial investigation/feasibility study database was adequate for these decisions. This Record of Decision recognizes that additional monitoring data must be gathered as part of the next phases of the project to more accurately assess source control, natural recovery rates, and the volume of contaminated sediments.

1.1.4. The Puyallup Tribe of Indians has not been provided a meaningful opportunity to participate in the development of the feasibility study. The Puyallup Tribe of Indians also maintains the feasibility study should take into consideration EPA's proposed NCP which implements SARA.

Response: The involvement of the Puyallup Tribe at the CB/NT site has been important in the remedial investigation/feasibility study as a member on the Technical Oversight Committee from 1983 to 1988. For example, the Puyallup Tribe was instrumental in identifying habitat and marine resource issues that were included in the feasibility study. The Superfund Cooperative Agreement between the Puyallup Tribe and EPA (April 1989) was the first in Region 10, and establishes the Puyallup Tribe as a supporting management agency for the project. The role of the Puyallup Tribe as a supporting agency in the selection of remedy has been important to the project and significant to the Puyallup Tribe as evidenced by their concurrence on the selected remedy. The combination of the Puyallup Tribe's historical involvement at the CB/NT site and their current status as a supporting project management agency suggests a meaningful opportunity to participate.

1.1.5. The feasibility study has failed to take into consideration the fact that much of the contamination targeted for remedial action (in some areas) is a result of a "federally permitted release" and therefore not actionable under CERCLA.

Response: Section 107(j) of CERCLA provides that response costs or damages incurred by the United States resulting from a "federally permitted release" are not recoverable under CERCLA, but only pursuant to existing law, such as other applicable federal statutes or common law. Section 101(10) of CERCLA defines a federally permitted defense by specifically enumerating certain releases in compliance with permits or authorized under federal or state environmental laws. EPA proposed regulations to define the scope of this exemption on 19 July 1988 (53 Federal Register 27268), with subsequent notices appearing in the Federal Register on 11 July 1989 (54 Federal Register 29306) and 9 August 1989 (54 Federal Register 32671). At this time, the regulations are not final.

The feasibility study is not required to evaluate or enumerate federally-permitted releases. Although there may have been federally permitted releases at the Commencement Bay site, it is not necessary to examine whether a release was federally permitted at this time. The burden of proving a federally permitted release rests with the party claiming this defense to liability. Its application is likely to be limited at the Commencement Bay site and may be more appropriately evaluated on a case-by-case basis by EPA during the cost-recovery enforcement and negotiation process.

1.1.6. Considering urban runoff, historical sources, and NPDES-permitted discharges exempt from CERCLA coverage, the Superfund should be tapped to pay at least a portion of the remediation costs at Commencement Bay.

Response: Liability under CERCLA is strict, joint, and several, meaning any party liable under Section 107(a) of CERCLA may be held responsible for reimbursement of all of EPA's costs. With the exception of federally permitted releases, there is no defense for historical contamination sources or urban runoff. Superfund monies have been used to date to pay for the entire remedial investigation/feasibility study and related enforcement costs. EPA will aggressively pursue recovery of these costs from the over 100 named PRPs at the site, and will attempt to reach settlement agreements with the PRPs for future remedial action described in the Record of Decision. To the extent that no viable PRPs are available, or if they are able to successfully prove a defense to liability, EPA may use Superfund monies for such cleanup (consistent with EPA guidance, e.g., for mixed funding) or seek to recover such costs from the other PRPs.

1.1.7. The proposed plan would not satisfy the CERCLA preference for onsite remediation where feasible.

Response: The selected remedy satisfies the preference for onsite remediation since the selected suite of sediment confinement options includes feasible onsite options including *in situ* capping, confined aquatic disposal, nearshore confinement, and upland disposal, all of which are to be implemented onsite.

1.2. Comments Related to Coordination with Other Programs

1.2.1. While apparent effects thresholds (AETs) satisfy cleanup goal requirements, these may or may not be in agreement with final state sediment quality standards. The use of alternative criteria would have major impacts on remediation plans and costs. This issue and any potential conflicts should be resolved before selection of a final remedial alternative.

Response: As noted by the commenter, the AET approach is one of the alternatives for developing state sediment quality standards and satisfies the criteria for identifying sediments having adverse effects on biological resources. Interim standards to address Element P-2 of the 1989 Puget Sound Water Quality Management Plan (PSWQA 1988) are in the process of being released by Ecology. These standards will be used to identify an inventory of contaminated sediments to be managed through various programs but not as enforcement standards for sediment cleanup. The target cleanup levels at the CB/NT site are generally higher concentrations than the interim standards as currently proposed. The PSWQA (PSWQA 1989) has supported the use of the amphipod and oyster embryo bioassays and benthic infauna analysis and the lowest AET associated with these three tests to measure compliance with the long-term cleanup goal in Commencement Bay. However, as with any Superfund project, as applicable standards and requirements are promulgated at either the federal, state, or tribal level, they will be evaluated by EPA in relationship to this Record of Decision to determine whether the selected remedy can still be considered adequately protective of human health and the environment.

1.2.2. The relationship between routine dredging projects under PSDDA and sediment remediation under CERCLA is not clear because the CB/NT sediment quality objectives are slightly more stringent than the PSDDA guidelines for open-water, unconfined disposal of sediments. Will sediments within a CB/NT problem area that pass PSDDA guidelines be accepted for disposal at a PSDDA disposal site?

Response: As a general policy, the EPA Superfund program does not intend to require PRPs to remediate sediments that could be taken to a PSDDA site. Such sediments would likely be in marginally contaminated portions of problem areas that are predicted to recover naturally and will therefore not require active remediation under Superfund. Sediments passing PSDDA guidelines may, therefore, be considered for disposal as non-Superfund wastes under Clean Water Act Section 404 regulation at a PSDDA disposal site. However, there may be situations where PRPs will be required to undertake sediment cleanup actions for sediments that pass the PSDDA guidelines. Examples of such situations include the following: elevated concentrations of PCBs or other contaminants that have a high potential for bioaccumulation in a nearshore area, but demonstrate relatively low toxicity in laboratory tests; elevated concentrations of contaminants that are highly toxic to benthic communities but exhibit relatively low toxicity in laboratory tests; highly contaminated surface sediments with relatively clean underlying sediments; and elevated contaminant concentrations at sites with low sedimentation rates.

Based on available sediment data, it does not appear that problem sediments requiring active remediation will pass the PSDDA guidelines. If they do pass, but are removed as part of the Superfund enforcement action, it is unlikely that they would be accepted at a PSDDA disposal site.

1.2.3. Ecology and EPA should continue to monitor activities in areas other than the CB/NT problem areas and require site characterization and remediation when warranted.

Response: Although agency oversight of Superfund response actions for CB/NT source control and sediment remediation will be limited to the problem areas described in this Record of Decision, EPA and Ecology will continue to investigate and regulate activities in other portions of the site. However, in areas that were not identified as high priority, the agencies will administer and enforce environmental laws and regulations including CERCLA authorities, but not as response actions related to the CB/NT site. Ecology's Commencement Bay UBAT, for example, will continue to coordinate its efforts with several other Ecology programs to address contaminated properties, wastewater discharges, air emissions and storm drains that are within the CB/NT site but not related to Superfund response actions at the site. Similarly, various other federal, state, tribal, and local programs will continue to be implemented throughout the site in circumstances that may not be related to the CB/NT selected remedy.

1.2.4. What is the regulatory status of the integrated action plan and what is its relationship to the Record of Decision? What is the process for public comment on the integrated action plan?

Response: The integrated action plan was part of the overall feasibility study for the CB/NT site and is used for resource planning and scheduling, rather than for scheduling of compliance actions. The timetables outlined in the integrated action plan are intended to be updated on an annual basis to reflect changes as overall project implementation proceeds. The integrated action plan was therefore part of the material which the public was invited to comment on during the public comment period. Because this planning document will be updated periodically, new comments and concerns should be raised to the agencies as they arise, and where possible and consistent with the law and the selected remedy, changes may be made. Information exchange between the agencies and the affected community should also be enhanced through Technical Discussion Group meetings as described in Section II of the Responsiveness Summary.

1.3. Comments Related to ARARs and TBCs

1.3.1. The 1989 PSWQA plan goals should be adopted as applicable or relevant and appropriate requirements (ARARs).

Response: The 1989 PSWQA plan does not provide promulgated criteria, standards, or requirements; rather it requires their development. Because the plan does not provide applicable or relevant and appropriate standards, criteria, or requirements, it is not listed as an ARAR. However, several plan elements (e.g., Elements P-6, P-7, P-2, and S-4) call for the development of ARARs at some point in the future. These elements are listed as major requirements, guidelines, and policies to be considered (TBCs) in the Record of Decision, in accordance with EPA guidance on compliance with other laws.

1.3.2. Maximum Contaminant Level Goals, the Indian Religious Freedom Act, and the National Historic Preservation Act must be adopted as ARARs.

Response: In a clarification letter from the Puyallup Tribe of Indians to EPA (22 August 1989), these laws were not cited as applicable or relevant and appropriate requirements and have not been included for this reason.

1.3.3. Promulgated allowable concentrations in fish of PCBs and mercury should be considered as ARARs.

Response: There are no promulgated criteria or standards for PCBs and mercury concentrations in fish tissue. The cleanup goal selected for PCBs in sediment is based on conservative risk assessment modeling. A sediment PCB concentration of 150 μg/kg (the cleanup goal) would be expected to result in a mean fish concentration of 37 μg/kg (wet weight) or less than 0.02 of the FDA action level for PCBs (2,000 μg/kg). FDA action levels are included in the list of major chemical-specific TBCs; however, they incorporate economic considerations as well as risk assessment calculations. Site-specific risk information, as developed for this Record of Decision is generally considered to be more appropriate for setting cleanup objectives. There are currently no tools available for estimating sediment mercury concentrations relative to fish tissue concentrations except risk assessment methods similar to those described in this Record of Decision.

1.3.4. Protection of human health and the environment must be the most important evaluation criteria. Federal and tribal standards must not be violated.

Response: EPA recognizes the importance of these factors in the decision-making process. CERCLA guidance requires that each remedial alternative be evaluated according to specific criteria. Both factors mentioned in this comment are reflected in what are considered the "threshold criteria" for evaluating cleanup alternatives. The threshold criteria must be met by the candidate alternatives for further consideration as possible remedies. The threshold criteria are 1) overall protection of human health and the environment, and 2) compliance with ARARs (where appropriate or relevant and appropriate federal, state, and tribal regulations are applied).

1.3.5. Interim tribal water quality standards must be considered as ARARs.

Response: The Record of Decision lists Puyallup Tribal Council Resolution No. 151288C (resolution adopting the Puyallup Tribal Water Quality Program) as a chemical-specific ARAR because this resolution adopts Washington Water Quality Standards and requires nondegradation and enhancement of water quality (this resolution also applies to sediments).

1.3.6. The Puyallup Tribe of Indians' cultural and spiritual ties to the contaminated site must be considered in the selection of remedy.

Response: Tribal Council Resolution No. 71288 is listed in the Record of Decision as a TBC. This resolution requests EPA to include tribal environmental standards within the feasibility study, and includes by reference the Tribe's fishing rights and cultural and spiritual ties to the CB/NT site.

1.3.7. The Puyallup Land Claims Settlement should be included as an ARAR.

Response: The land claims settlement is included as an ARAR for the site because it was recently promulgated as federal law and because it specifies enhancement of fish resources in the Puyallup Delta.

2. HUMAN HEALTH RISKS (SEAFOOD CONSUMPTION)

Two main categories of comments on the Commencement Bay health risk assessment and feasibility study were received. In the first series of comments, the reviewers maintained that the human health risk assessment (Versar 1985) for the CB/NT remedial investigation overestimates risks to consumers of fish and shellfish in the study area. The major comments in support of this position were submitted by the Commencement Bay Group, as prepared by ENSR (1989), and Pennwalt (1989). Other comments supporting this position included Manke Lumber (1989), Pickering (1989), Port of Tacoma (1989), public and environmental group (1989), and City of Tacoma (1989). In the second category of comments, the Puyallup Tribe of Indians (1989) maintained that the remedial investigation/feasibility study risk assessment underestimates health risks to humans consuming fish and shellfish in Commencement Bay. They suggest that the remedial investigation/feasibility study risk assessment should address cumulative health impacts to tribal families that rely on fish for large portions of their diets.

The risk estimates based on contaminant concentrations in English sole muscle tissue as part of the CB/NT remedial investigation are approximately 5 times higher than those calculated as part of the ENSR (1989) comments. The average risk estimates calculated as part of the CB/NT remedial investigation would be lower than estimates taking into account factors such as high seafood consumption rates by tribal Indians. The risk estimates for PCBs in English sole calculated during the CB/NT remedial investigation are therefore intermediate in magnitude between those estimates suggested by various commenters on the feasibility study.

2.1 Comments Related to Baseline Risk Calculations for Human Health

2.1.1 The feasibility study overestimated the human health risks in Commencement Bay by nearly an order of magnitude. This lower risk is within the generally acceptable range and is comparable to the risk reported in the feasibility study for the reference area, Carr Inlet. This indicates that sediment clean-up based on human health risk is not warranted in Commencement Bay.

Response: The baseline risk assessment for the CB/NT remedial investigation indicates an unacceptable excess risk compared with other Puget Sound reference areas. The assessment concentrated on PCBs and arsenic in muscle tissue of English sole and crab. Only PCB contamination was predicted to produce more than one cancer case over a 70-year exposure period in the exposed population. Risks from arsenic consumption in Commencement Bay seafood were less than corresponding risks in the Carr Inlet reference area. Based one these data, only data for PCBs were used in the feasibility study to establish a target cleanup level for sediments.

Only two sets of data are available to evaluate the relative excess risk of cancer associated with PCBs in English sole muscle tissue in the CB/NT waterways compared with reference areas of Puget Sound: a study by Gahler et al. (1982) and the remedial investigation (Tetra Tech 1985). Assuming equivalent fish consumption rates in the CB/NT waterways and reference area, the estimated risk of cancer associated with contamination of English sole muscle tissue would be directly related to the concentration of PCBs in the fish. Based on the data of Gahler et al. (1982) and the remedial investigation (Tetra Tech 1985), cancer risk associated with PCBs in muscle tissue of English sole from the CB/NT waterways is an order of magnitude or more greater than that associated with PCB contamination in reference areas. Therefore, an excess risk of cancer exists in the waterways relative to remote and relatively uncontaminated areas of Puget Sound. The CB/NT remedial investigation also demonstrated that PCB concentrations in English sole muscle tissue from the CB/NT waterways are elevated relative to those along the southwest shoreline of the bay.

The CB/NT remedial investigation estimated individual cancer risks for consumption of PCB-contaminated fish to be somewhere in the range from 6×10^{-3} to 2×10^{-5} (depending on the assumed consumption rate). Risk levels of 10^{-4} to 10^{-5} are higher than EPA's point of departure (i.e., 10^{-6}) for determining remediation goals. An additional lifetime cancer risk greater than 1×10^{-3} is definitely considered unacceptable. Thus, the predicted lifetime risks associated with PCB contamination of English sole muscle tissue in the CB/NT waterways may present an unacceptable excess risk compared with reference areas of Puget Sound.

Further discussions related to this comment are provided in the following portions of this section.

2.1.2. The estimate of carcinogenic potency for PCBs may be incorrect.

Response: A carcinogenic potency factor of 4.34 (mg kg^{-1} day^{-1})$^{-1}$ was used in the CB/NT remedial investigation to calculate PCB risk from fish consumption. ENSR (1989) used a value of 7.7 (mg kg^{-1} day^{-1})$^{-1}$ for the carcinogenic potency of PCBs to estimate risks from fish consumption in Commencement Bay. A value of 7.7 is the current carcinogenic potency factor estimated for PCB 1260 by EPA, and was used in the feasibility study to establish recommended cleanup goals for PCBs at the site. Use of the higher carcinogenic potency estimate in a revised baseline risk assessment for Commencement Bay would result in higher risk estimates by a factor of approximately 1.8 from those reported in the remedial investigation.

2.1.3. The selection of English sole as an indicator species was inappropriate for the risk assessment. The feasibility study should have used data for species that are more commonly harvested by local fishermen such as market squid, salmon, Pacific hake, and Pacific cod. This would have resulted in lower risk estimates because commenters further claimed that concentrations of PCBs in the commonly harvested species would be lower than those in English sole.

Response: The selection of English sole for the remedial investigation risk assessment was appropriate because the species could be used as an indicator for both human health and ecological risk assessment. English sole were selected because they occur in relatively large numbers in Commencement Bay. English sole also live in closer association with the sediments and would be expected to accumulate bioavailable contaminants in sediments. They were cited in the remedial investigation report (Tetra Tech 1985) as a conservative indicator of the maximum contaminant levels that would be expected to occur in edible tissue of harvested fish species. The remedial investigation acknowledges that English sole are not commonly caught by local fisherman. English sole does not necessarily represent the most contaminated species among those harvested by recreational anglers. Available data from the CB/NT waterways and Puget Sound as a whole suggest that PCB concentrations in muscle tissues of other fish species may be higher than those in English sole (Gahler et al. 1982, Tetra Tech 1985). Based on a limited number of samples, Landolt et al. (1985) found the opposite pattern (i.e., concentrations of PCBs in muscle tissue of English sole were lower than those in some commonly harvested species). Tetra Tech (1988, Figure 6) showed that mean concentrations of PCBs in muscle tissue of Pacific cod was higher than that for English sole based on data collected throughout Puget Sound. The mean concentration of PCBs in English sole (approximately 180 µg/kg wet weight) throughout Puget Sound was within a factor of approximately two times the concentration in commonly harvested species (i.e., starry flounder, Pacific hake, Chinook salmon, and rockfish) (Tetra Tech 1988).

The data cited by commenters (ENSR 1989) to support selection of commonly harvested species applied to all urban bays sampled by NOAA in 1985, not just in Commencement Bay. Moreover, corrections of consumption rate data to account for seasonal availability of species [which were not performed by ENSR (1989)] would affect the choice of dominant species in the diet of recreational anglers. PCB concentration data selected by ENSR (1989) in their alternative baseline risk assessment are biased toward low values when all data for commonly harvested species and English sole are considered. Concentration data in ENSR (1989) may have been biased toward low values because sampling locations where fish were collected were not considered (see response to Comment 2.1.5).

2.1.4. Fish consumption rates may be overestimated or underestimated.

Response: Estimates of seafood consumption rate to be used in a risk assessment depend on human subpopulations surveyed, seasonal availability of fish species, and assumptions used to calculate consumption rates from survey data. Many limitations are inherit in surveys for fish consumption rate data (Landolt et al. 1985; Pastorok 1988). Because of the uncertainties in estimating fish consumption rate, it is appropriate to use a conservatively high estimate in risk assessment. As noted earlier, risk estimates in the remedial investigation were presented for a range of consumption rates. The estimate of approximately 12 grams/day used in the feasibility study to generate a PCB cleanup objective represents the average consumption rate for Puget Sound anglers, but only about 10 percent of the anglers surveyed in Commencement Bay (Pierce et al. 1981) apparently consume seafood at a higher rate than that. The value of 12 grams/day also corresponds to the approximate average fish consumption estimated for Puget Sound anglers (Tetra Tech 1988). Adjustment of consumption rates for seasonal availability of fisheries may result in a lower estimate, but uncertainties regarding actual changes in harvest and consumption over an annual period make such corrections tenuous. Moreover, anglers may shift species preference as the availability of species changes over the year, while maintaining an approximately constant consumption rate. Therefore, the estimate of 12 grams/day represents an appropriate moderate consumption rate for recreational anglers for use in a risk assessment. However, this rate is less than the consumption rate for special subpopulations that may rely on local seafood for a large portion of their diet (e.g., consumption rates in excess of 1 pound/day were also identified in the Commencement Bay survey.

2.1.5. The effects of fishing location preference and a mixed seafood diet should be considered in developing risk estimates.

Response: Gahler et al. (1982) and the CB/NT remedial investigation (Tetra Tech 1985) provide the only data sets available for PCB concentration in muscle tissue of fish from the CB/NT waterway system. Data cited by some reviewers in support of an alternative risk assessment were taken from Tetra Tech (1988) and Landolt et al. (1985). Station locations for these studies were primarily away from the waterway system either in Commencement Bay proper (e.g., salmon data) or along the southwest shoreline of the bay. Because PCB concentrations in fish collected from the waterway system are substantially higher than those collected from other locations in Commencement Bay, data for open waters of the bay and the southwest shoreline are inappropriate for use in estimating risks associated with consumption of fish from the waterways.

2.1.6. Cumulative health risks from all dangerous chemicals such as 2,3,7,8-tetrachlorodibenzodioxin must be addressed in the establishment of a protective cleanup objective.

Response: As explained in the Record of Decision (Section 7), PCB mixtures were the only CB/NT chemicals of concern posing a human health risk above reference conditions and therefore warranting remedial action under Superfund. However, recent information developed during EPA's National Bioaccumulation Study indicates that contamination by chlorinated dioxin and furan isomers in CB/NT fish and shellfish may be comparable in terms of human health risk to those associated with PCB contamination. Thus, baseline health risks identified in the remedial investigation may be low by a factor of two. The study did not present sufficient data to compare chlorinated dioxin and furan contamination in sediments and biota with reference areas in Puget Sound, nor is it sufficient to determine the spatial distribution of contamination in Commencement Bay. Additional data will be collected as a result of planned EPA studies and as part of sampling of selected CB/NT sources and problem areas during the remedial design phase. These additional data will be used to evaluate the protectiveness of the selected remedy relative to chlorinated dioxins and furans prior to implementation of sediment remedial action.

2.1.7. The method of fish preparation for consumption may reduce contaminant concentrations. Cooking in particular may result in up to an 80 percent reduction in the PCB concentration in ingested fish.

Response: It is recognized that the various methods of preparing fish for consumption may affect concentrations of PCBs in tissue consumed. Although some studies report that cooking can substantially reduce PCB concentrations in fish tissue, other studies have shown that PCB loss during cooking may be as little as 2 percent. Some cooking methods also activate or create carcinogenic chemicals. Because of the uncertainties about the net effects of cooking on PCB concentrations, corrections for the effects of cooking in the risk assessment are not possible at this time. Although the lack of correction for PCB loss in cooking may result in a slight overestimate of risk, the use of data for skinned fillets during the CB/NT remedial investigation would tend to underestimate risk. Studies have shown that PCB concentrations in unskinned fillets are higher than those in skinned fillets. Landolt et al. (1985) estimated that 19 percent of the meals consumed by Commencement Bay anglers consisted of unskinned fillets. Therefore, the actual method of fish preparation may result in either higher or lower estimated risk when compared to direct assessment of raw, skinned fillets. Because of this uncertainty, PCB concentrations were not adjusted for the preparation technique prior to consumption.

2.2. Comments Related to Cleanup Level for Human Health

2.2.1. The sediment quality objective for PCB mixtures represent a level of excess risk that is not protective to the 10^{-6} level.

Response: The sediment quality objective for total PCBs at the CB/NT site represent an excess risk level of 10^{-5} for a consumption rate of 12 grams/day of English sole. The objective was established relative to both risk assessment calculations and ambient levels of PCBs in English sole caught in reference areas (which also correspond to 10^{-5} risk levels). Management of site risks was based on an assumption that it would be infeasible to establish sediment quality levels at the CB/NT site that were cleaner than reference areas. Thus, high consumers of seafood at the CB/NT site may experience risks in excess of the 10^{-6} level, even after site remediation is complete, but it will be similar to reference area risks.

3. ENVIRONMENTAL RISKS (SEDIMENTS)

Potential environmental risks of sediment contamination were evaluated in the CB/NT feasibility study using a suite of biological indicators, including sediment bioassays and *in situ* evaluations of the benthic macroinvertebrate assemblages indigenous to the bay. The primary objective of these evaluations was to provide a direct measure of the effects of sediment contamination to determine baseline risks to Commencement Bay biota. These measures were made by making statistical comparisons to conditions at relatively uncontaminated reference areas. The cleanup goals derived from the biological assessments were focused on minimizing the risk of future adverse biological effects as a result of sediment contamination in the bay.

Three major kinds of comments were received with respect to the biological indicators used in the CB/NT feasibility study. They include 1) those related to the appropriate use of biological indicators and reference areas in general, 2) those related specifically to sediment bioassays and benthic macroinvertebrate analyses, and 3) those related to the appropriateness of the cleanup goal based on environmental health. In this section, the major issues related to each of the three kinds of comments are discussed. The use of various biological indicators as assessment tools, their calculation, and application in developing the cleanup goal were questioned by several PRPs; their comments were generally summarized by ENSR (1989). The lack of chronic tests (or the exclusion of the Microtox test) for use as an assessment tool was questioned by NOAA Ocean Assessments Division, the Puyallup Tribe of Indians, and the Sierra Club.

The rationale for the selection of the biological indicators used in the CB/NT remedial investigation and the AET database is an important consideration for these issues. Biological testing was used to determine impacts of sediment chemical contamination for several major reasons. First, it allows evaluation of the potential effects of chemicals for which standards are not available and chemicals that may not be measured during typical assessments. Second, it allows assessment of the effects of complex mixtures and thereby accounts for interactions among chemicals (e.g., additive, synergistic, antagonistic). Finally, biological testing provides an empirical assessment based on the actual bioavailability of chemicals in sedimentary environments.

3.1. Comments Related to Baseline Risk Concepts for Environmental Protection

3.1.1. Appropriateness of baseline risk assessment targets some sediments for active remediation where there may be thriving ecological communities.

Response: The environmental risk assessment focused first on toxic chemicals in the marine environment with respect to reference areas, and second on the relationship to ecological function. It was recognized that all biological measurements (as well as chemical measurements) have a certain amount of uncertainty associated with their measurement and interpretation. This uncertainty arises largely from the complexity of biological systems. Because of this uncertainty, multiple biological indicators were used in the remedial investigation and AET database. The use of multiple indicators allowed impacts to be determined using a preponderance-of-evidence approach. That is, as more indicators identified a station as impacted, confidence increased that the station was truly impacted. (See the responses to Comments 3.2.3 and 3.2.4 for additional discussion on the appropriateness of designating adverse impacts based on laboratory bioassays compared with *in situ* benthic analyses.)

3.1.2. The reference areas selected for evaluation of benthic macroinvertebrates may be inappropriate.

Response: The appropriateness of the reference areas used to evaluate potentially impacted sites was questioned. Several commenters suggested that the reference areas did not match the potentially impacted areas with respect to all important characteristics, and that effects determined at the latter sites may have been due to characteristics other than chemical toxicity.

It is recognized that the characteristics of benthic macroinvertebrate assemblages are influenced by a wide variety of physical, chemical, and biological variables. Because there are so many potentially important variables, it is unlikely that a perfect reference area can be found for any potentially impacted site. Instead, it is more practical to select a reference area that is as similar as possible to the potentially impacted sites with respect to the most important variables. For the remedial investigation and AET database, the variables used to select reference sites were season, depth and sediment character (represented by sediment grain size). These variables are three of the most important ones known to influence the characteristics of benthic macroinvertebrate assemblages (Gray 1981). In addition to these three major variables, the artificial environment created by the manmade waterways of Commencement Bay was addressed by selecting a manmade waterway (i.e., Blair Waterway) as the reference area for those environments.

3.2. Comments Related to Baseline Risk Calculations for Environmental Protection

3.2.1. There is a lack of ecological relevance for bioassay test species used in the remedial investigation and the AET database. Because these indicators do not measure in situ biological effects, they have little ability to predict impacts on the CB/NT ecosystem. The use of major taxa (i.e., Polychaeta, Mollusca, Crustacea) is too crude of a response variable to determine impacts accurately; much valuable information is lost by not considering species abundances.

Response for use of bioassay test species: As mentioned in the introduction to this Response Section 3, the bioassay test species were selected because they are residents of Puget Sound and are relatively sensitive to chemical contamination. Their use in assessing sediment contaminant impacts has been established in many studies in Puget Sound and elsewhere (PTI and Tetra Tech 1988; Chapman et al. 1985, 1987). Because they represent one of the most sensitive ecosystem components, their evaluation is assumed to be protective of the larger ecosystem. The use of bioassays as indicators for larger groups of organisms has a strong historical precedent. Most of the EPA water quality criteria used to protect aquatic life in the U.S. has been derived directly from water-column bioassays conducted on sensitive species.

Response for use of major taxa: Although patterns based on species abundances were analyzed and discussed in the remedial investigation, major taxa were selected as the indicators of benthic effects for several reasons. First, abundances of major taxa generally exhibit less variability than species abundances and therefore are more amenable to impact determinations based on statistical criteria. Second, the use of major taxa avoids many of the uncertainties associated with interpreting the causes and significance of subtle shifts in species abundances at different locations. Finally, it was assumed that large reductions in the abundances of species groups (i.e., those species pooled within each major taxon) would be more meaningful ecologically than reductions in the abundances of single species. Although different species may exhibit variable responses to different kinds of environmental pollution, several investigators (Pearson and Rosenberg 1978; Rygg 1985, 1986) have suggested that most taxa will exhibit reductions in abundance in response to chemical contamination. Use of major taxa as an indicator should therefore reflect the patterns of abundance of most species.

3.2.2. Non-toxic effects can bias the biological indicators used to assess toxic effects. For example, low dissolved oxygen may bias results of the bivalve larvae abnormality test and sediment grain size may affect results of the amphipod mortality test.

Response for bivalve larvae abnormality test: Low concentrations of dissolved oxygen (i.e., <4 mg/L) were found in the test chambers for the bivalve larvae abnormality test for six stations in Commencement Bay. Several commenters suggested that the observed abnormalities at these stations may have been due to the low levels of dissolved oxygen rather than to chemical toxicity.

The potential confounding effects of low concentrations of dissolved oxygen at the six stations were discussed in the remedial investigation. Significant ($P<0.05$) values of abnormality were found at all six stations. To be environmentally protective, the significant abnormalities were attributed to chemical toxicity, rather than low levels of dissolved oxygen. The assumption that chemical toxicity was largely responsible for the observed values of abnormality was supported by results based on the other biological indicators and sediment chemical concentrations. Significant ($P<0.05$) amphipod mortality was found at four of the six sites, and significant depressions in the abundances of major benthic macroinvertebrate taxa were found at all six sites. In addition, concentrations of various chemical contaminants were greater than 100 times the levels found in reference sediments at all six sites.

Response for amphipod mortality test: The amphipod test does not display high mortalities in CB/NT sites with low levels of sediment contamination that would indicate substantial effects due to particle size. DeWitt et al. (1988) have demonstrated that sediments having a high percentage of fine-grained material can cause mortality in the amphipod test in the absence of chemical contamination. Several commenters suggested that the effects of sediment grain size may have confounded the results of the amphipod mortality tests and resulted in erroneous impact designations.

The potential confounding effects of sediment grain size in the amphipod test was acknowledged in the remedial investigation. However, the effects of grain size are highly unpredictable. In the reference-area database used by DeWitt et al. (1988), mortality ranged from 0 to 70 percent at values of percent fine-grained sediment greater than 70 percent. The considerable scatter in the data resulted in a regression relationship that, while significant ($P<0.05$), could explain only 29 percent of the variability. Given this uncertainty, all test results judged significant ($P<0.05$) in the remedial investigation and AET database were considered the result of chemical toxicity. This approach ensured that all impact designations were environmentally protective.

The reliability of the amphipod data in detecting contaminant effects is further substantiated by the general concordance with other bioassay tests, infauna analyses, and by the high degree of sediment contamination typically present at CB/NT sites that displayed significant amphipod toxicity.

3.2.3. Toxicity and biological indicators show inconsistencies in defining impacted areas.

Response: A number of differences were found among the biological indicators with respect to the stations identified as impacted and not impacted. Several commenters suggested that because the indicators were not in perfect agreement, they were not meaningful.

Different species commonly exhibit substantial differences in sensitivity to chemical contaminants. In addition, different life stages (e.g. larval, juvenile, adult) within a species frequently show variable sensitivities. It therefore is not surprising that differences among indicators were found with respect to impact designations. Multiple biological indicators were used in the remedial investigation and AET database specifically because of the different sensitivities expected among species and life stages. It was recognized that no single indicator could be considered representative of all the organisms present in the CB/NT ecosystem. By using multiple indicators, contaminated areas could be evaluated using a preponderance-of-evidence approach.

Notwithstanding the acknowledged differences among the biological indicators, overall agreement of test results was relatively high. Williams et al. (1986) found a significant correlation ($r=0.86$, $P<0.001$) between the results of the amphipod mortality and bivalve larvae abnormality tests. Becker et. al. (1987) found that concordance of impact designations based on the bivalve larvae abnormality test and the three kinds of major benthic taxa (i.e., *Polychaeta, Mollusca, Crustacea*) ranged from 68 to 76 percent and were significant ($P<0.05$, binomial test) in all cases. Concordance between the results of the amphipod mortality test and the major taxa was somewhat less (59-62 percent) and not significant ($P>0.05$) in any instance. These results suggest that the biological indicators used in the remedial investigation and AET database were in general agreement with respect to impact designations, but that indicator-specific differences were also present. Therefore, the use of multiple indicators resulted in general substantiation of adverse effects in high priority areas while also ensuring the detection of effects due to species-specific factors in contaminant sensitivity or exposure route.

3.2.4. Use of statistical criteria ɩo define impacts may be inappropriate.

Response: A primary criterion in selecting the biological indicators used in the CB/NT remedial investigation and the AET database was ecological relevance. Benthic macroinvertebrate assemblages were selected because they are a critical link in detrital-based ecosystems for energy transfer to higher trophic levels (e.g., larger invertebrates and fishes). In addition, because these organisms are relatively stationary and live in close association with bottom sediments, they represent an ecosystem component with one of the highest risks of being affected by sediment contamination. It was therefore assumed that evaluations based on benthic macroinvertebrate assemblages would be protective of most of the remaining ecosystem in the bay.

Sediment bioassays were used in the remedial investigation and the AET database because they allowed an evaluation of sediment toxicity under controlled laboratory conditions. To ensure that the bioassays used in the remedial investigation and AET database were ecologically relevant, the test species were selected on the basis of their presence in Puget Sound and their sensitivity to contamination. Both the amphipod *Rhepoxynius abronius* (used in the amphipod mortality test) and the Pacific oyster *Crassostrea gigas* (used in the bivalve larvae abnormality test) are members of the Puget Sound ecosystem. In addition, both are considered relatively sensitive to chemical contamination and are therefore representative of the ecosystem components most likely to be affected by sediment contamination. It was therefore assumed that evaluations based on these bioassays would be protective of the larger ecosystem.

Statistical criteria were used in the biological evaluations because they allowed explicit hypotheses related to impacts to be tested in an objective manner, and with a known degree of confidence. The use of statistical criteria removed much of the potential subjectivity involved in determining whether a biological effect was important. Although ecological relevance was not addressed directly, it was considered indirectly by the choice of biological indicators. In addition, the magnitude of effects determined to be statistically significant were large enough to be considered ecologically important. For the two sediment bioassays, effects (i.e., amphipod mortality and oyster larvae abnormality) were generally found to be significant when responses were found in more than 25 percent of the test organisms. For the benthic macroinvertebrate analyses, effects were generally determined to be significant when organism abundances were less than half the values observed in reference areas. Therefore, the statistical tests used in the remedial investigation did not result in the detection of very small changes in toxicity or benthic abundance.

Impact designations and biological test procedures described in the Record of Decision will continue to be adjusted in accordance with changes in Puget Sound Estuary Program protocols. These changes may result in 1) changes in the AET database, 2) changes in test evaluation procedures, or 3) replacement of any of the three biological indicators by more appropriate tests, as described in Section 8.2.5 of the Record of Decision.

3.3. Comments Related to Cleanup Goal for Environmental Protection

3.3.1 The cleanup goal of "no acute or chronic adverse effects on biological resources" represents pristine conditions in an area that is an active port. For the remedial action evaluation criteria, the apparent goal of converting the waterways to the conditions of unindustrialized deep aquatic environments is inconsistent with their original condition as mudflats and the reality of their current use by industry. An achievable and sustainable sediment cleanup objective and standard should be established before implementing sediment remediation.

Response: The goal of the CB/NT project is not to restore the environment that predated man's arrival in Commencement Bay. The goal of the project is to ensure that the environment is not acutely toxic to organisms that would ordinarily inhabit it and does not pose significant human health risks, as mandated by Superfund regulations and allows for the continuation of the native American fishery as mandated by treaty. The cleanup goal represents conditions that currently exist in urban and nonurban areas of Puget Sound (including parts of the CB/NT site), not pristine conditions. As stated in the Record of Decision (see Section 7), the long-term cleanup objective represents chemical concentrations that are well above reference area concentrations. Moreover, the reference conditions used to discriminate adverse biological effects for the remedial investigation and AET database were not based on pristine conditions.

The reference areas used for sediment bioassays have included nonurban embayments such as Carr Inlet, Port Susan, and Sequim Bay. Although these embayments are not influenced by major sources of chemical contamination, none of them can be considered pristine because of other local human impacts and indirect contamination at low levels via air and water circulation throughout Puget Sound. The closest approximation to pristine conditions used for the sediment bioassays are the sediment samples from West Beach on Whidbey Island and clean seawater that are used as negative controls for the bioassay testing. Because these controls are only used to determine the acceptability of bioassay results, they do not directly influence the determinations of cleanup objectives.

The reference areas used to evaluate adverse effects on benthic macroinvertebrates have included Blair Waterway (in Commencement Bay), Blakely Harbor, Carr Inlet, Port Susan, and central Puget Sound off Seahurst in West Seattle. As with the bioassay reference areas, none of the reference areas used to determine benthic effects can be considered pristine. This is particularly true for Blair Waterway, which was used as a fine-grained reference area for stations in other Commencement Bay waterways as part of the remedial investigation.

3.3.2. There is no adequate assessment of chronic effects in the AET values used in the feasibility study for assessing environmental risk.

Response: Reliance on acute responses (i.e., acute toxicity bioassays) to generate sediment quality values may not be protective of all chronic health impacts to aquatic organisms. Although AETs could be developed based on results of chronic laboratory tests, standardized tests to assess chronic adverse effects associated with sediment contamination were not available for the feasibility study. By necessity, AETs were developed using available biological indicators, and the sediment quality objective for the CB/NT site recognizes this practical limitation. The generation of AET values based on a variety of sublethal and lethal biological indicators does, however, address many complex biological-chemical interrelationships. The various biological tests used to generate AET values use sensitive species and are therefore representative of ecosystem components that are most likely to be affected by sediment contamination. These indicators include benthic infauna analysis that incorporates a measure of both *in situ* chronic and acute effects. These effects could include, for example, chronic toxicity to all life stages, behavioral changes, reproductive alterations, tumor inductions, and altered predator-prey relationships. For the CB/NT site, a significant response according to any one of the three acute biological indicators will be used as a criterion for presumptive harm during the cleanup phase because not all possible biological effects have been measured.

In addition to toxicity from measured contaminants, the AET approach also incorporates the net effects of the following factors that may also be important in field-collected sediments:

- Interactive effects of chemicals (e.g., synergism, antagonism, and additivity)
- Unmeasured chemicals and other unmeasured, potentially adverse variables
- Matrix effects and bioavailability [i.e., phase associations between contaminants and sediments that affect bioavailability of the contaminants, such as the incorporation of polycyclic aromatic hydrocarbons (PAH) in soot particles].

The AET approach cannot distinguish and quantify the individual contributions of interactive effects, unmeasured chemicals, or matrix effects in environmental samples, but AET values may be influenced by these factors. Only laboratory-spiked sediment bioassays offer a systematic and reliable method for identifying and quantifying these complex interactions. A great deal of research effort would be required to test the range of chemicals potentially occurring in the environment (both individually and in combination), a sufficiently wide range of organisms, and a wide range of sediment matrices to establish definitive criteria. The AET approach has an advantage over single chemical spiking studies because it incorporates the influence of these factors in the generation of AET values from field data.

4. THE APPARENT EFFECTS THRESHOLD APPROACH

Although the sediment quality objectives for the CB/NT site are defined according to three biological indicators and human health risk assessments, AET values developed for Puget Sound have been used as the primary technical basis for establishing chemical-specific sediment cleanup objectives relative to environmental protection at the CB/NT site. Three major kinds of comments with respect to use of the AET approach were received. They include questions concerning 1) the conceptual basis of the AET approach, 2) appropriate generation of AET values, and 3) appropriate regulatory applications of AETs in making cleanup decisions. Major issues related to these comments are addressed in this section.

The AET approach was supported as the best method available at the present time to identify sediments requiring remedial action or to estimate chemical concentrations associated with harm to marine life by Ecology, Washington Department of Natural Resources, PSWQA, the Commencement Bay Citizens Advisory Committee, the Sierra Club, and the NOAA Oceans Assessment Division. Various concerns over conceptual aspects of this approach were advanced by the Commencement Bay Group, the city of Tacoma, Foss Maritime, Kaiser Aluminum and Chemical Corporation, Manke Lumber Company, Pennwalt Chemical Corporation, and the Washington Department of Natural Resources. The Commencement Bay Group also proposed ecologically significant benthic effects AET be used as an alternative guideline for sediment assessment.

It was noted that site-specific biological data used to generate AET values were not available at every station sampled at the CB/NT site. Superior Oil Co. requested confirmation of chemical predictions prior to determining the need for sediment remediation. Regulatory issues raised by the city of Tacoma, Martinac Shipbuilding, Port of Tacoma, and Tacoma-Pierce County Chamber of Commerce included questions on the relationship of AET values used in the CB/NT feasibility study to proposed state sediment standards and whether AETs were being used to establish a goal of pristine conditions in Commencement Bay (this latter comment has been addressed in Section 3.3).

4.1 Comments on Conceptual Basis of the AET Approach

4.1.1. The AET approach does not provide an appropriate cleanup standard because AET values are strictly predictions of correlations, and fail to prove cause-effect relationships between contaminants and biological responses.

Response: This concern applies in practice to all sediment quality values available because none (including spiked sediment bioassays) can provide proof of cause-and-effect under actual field conditions. Research to assess the correspondence of AETs to toxicological studies has been recommended and is underway to a limited extent. However, cause-effect proof of harm is not required under Superfund to be included in the decision-making process at the national priority list sites. In the interest of protecting human health and the environment, Superfund law and guidance requires timely decisions and actions based on the best information available. Therefore, the potential for adverse biological and human health effects is sufficient to pursue regulatory actions at the CB/NT site. Proposed actions utilize a preponderance of evidence of the association of chemical contamination and adverse biological effects in assessing cleanup levels. The problem chemicals identified by the AET approach at a particular problem area represent a best effort to discern between measured chemicals that do not appear to be associated with adverse biological effects and those that do. In addition, because all potential contaminants cannot be measured routinely, cleanup strategies must also rely to some extent on the regulation and management of "surrogate" chemicals. If, for example, an unmeasured chemical (or group of chemicals) varies consistently in the environment with a measured chemical, then the AETs established for the measured contaminant will indirectly apply to, or result in the management of, the unmeasured contaminant. In such cases, a measured contaminant would act as a surrogate for an unmeasured contaminant (or group of unmeasured contaminants).

The correlative evidence of the AET approach in Puget Sound is based in part on field data on chemical contamination in CB/NT areas that evidence adverse biological effects by multiple indicators. The chemical contamination in many of these areas has been associated with particular sources both by chemical composition and by spatial distributions. This preponderance of chemical and biological evidence is judged to be sufficient in high priority areas considered in the feasibility study. Because strict cause-effect relationships are not proved, the AET approach is used as only one tool that guides the overall decision-making process. This protective assumption can be confirmed by optional site-specific biological testing in the remedial design phase.

4.2 Comments on the Application of the AET Approach for Decision-Making

4.2.1. The AET approach is used to establish cleanup goals solely on the basis of predictive capabilities. Confirmation of results is necessary before proceeding with cleanup. The approach should be used as a guideline rather than a strict standard.

Response: CB/NT sediment quality objectives are defined according to biological test results. The AET database is used only as a tool for predicting levels of chemical contaminants above which adverse effects would be measured using those tests. However, confirmation of chemical predictions using biological testing has been established as an option during the remedial design phase. The results of such site-specific testing would outweigh the AET prediction of biological effects and therefore determine the final action to be taken. Therefore, the AET approach is not being used as a strict standard for required sediment cleanup, only to provide a basis for estimating potential cleanup volumes of sediment. This application of biological testing and the AET database is similar to that used in other Puget Sound programs such as PSDDA, the Puget Sound Estuary Program, and emerging state standards and regulations.

4.2.2. Use of AETs is particularly questionable in intertidal areas.

Response: The different contaminated matrices to which AETs have been applied in the subtidal environment represent a broader range in matrix type, and associated variations in bioavailability, than do differences between subtidal and intertidal environments. Based on this consideration and preliminary reliability results for tests involving AET application to intertidal sediments, existing AET values have been recommended for use in identifying potential problem areas at intertidal stations in Puget Sound (Becker et al. 1989). Ongoing review of any additional verification data is also recommended. The sediment quality objective at the CB/NT site is based on biological test results that have been interpreted relative to conditions at suitable reference stations. Until further data can be evaluated, it may be appropriate for final remedial action decisions to rely on site-specific testing rather than the AET predictions in intertidal areas of the CB/NT site.

4.3. Comments Related to Chemical-Specific AET Values

4.3.1. In generating AET values, all effects are attributed to single chemicals although other factors could be relevant; water depth, turbulence, salinity, sediment texture can affect benthic abundance (and sometimes toxicity) and are not adequately addressed.

Response: The AET approach attempts to distinguish patterns of natural variability from those indicating toxic impacts by statistically comparing sample responses to reference benthic samples that have similar grain size distributions and are collected at similar water depths. This statistical comparison reduces the potential for habitat-related factors to confound the results or mask apparent relationships. The relationships observed between certain chemicals and benthic effects cannot be explained solely by habitat. In cases where potentially anomalous habitat variations and sediment toxicity could contribute to the statistical differences noted, the condition was protectively defined as an adverse biological impact.

This protective assumption can be confirmed by optional site-specific biological testing in the remedial design phase.

4.3.2. AETs fail to quantify the extent of adverse effects . . . The AET derivation process treats all statistically significant changes as equally adverse, without regard to their nature, magnitude, or ecological importance.

Response: AET values are designed to predict adverse effects that can be statistically distinguished from reference conditions. This magnitude of adverse effect is consistent with the need to address feasibly a long-term cleanup goal of no adverse effects. The magnitude of effect above this threshold is not directly taken into account in a single AET value but the range of AET values from lowest AET to highest AET for a range of biological indicators does provide a preponderance of evidence of different kinds of adverse effects. Of the 201 benthic infauna stations and 287 amphipod bioassay stations evaluated for 13 Puget Sound embayments with the AET approach (including Commencement Bay), approximately 85 percent (174 stations and 243 stations, respectively) are in accordance with the predictions of the 1988 AET values for these indicators (i.e., they do not exhibit adverse effects at chemical concentrations less than the AET values, and do exhibit adverse effects at chemical concentrations above the AET values) (U.S. EPA 1988). The reliability of AET values for the oyster larvae indicator was even higher, but only data for Commencement Bay were available for analysis. Therefore, the analysis correctly identifies impacted stations using several kinds of bioassessment techniques that employ different endpoints. These biological tests use sensitive species and are therefore representative of ecosystem components that are most likely to be affected by sediment contamination (see additional discussion in response to Comments 3.2.1 and 3.3.2). Sediment quality values that would focus only on severe adverse effects, or would otherwise be influenced by the magnitude of adverse effect that exceeded reference conditions would be less sensitive in identifying many of these measurable impacts than the AET values used at the CB/NT site.

4.4. Comments on the Establishment of AET Values for the CB/NT Site

4.4.1. Operationally, the AET is a concentration at which no effect occurred, not the concentration above which effects are always expected. Define AET as the contaminant concentration above which effects were always observed in the data set for which AET was derived.

Response: This precise definition is appropriate in order to be environmentally protective and has been incorporated.

4.4.2. [T]he goal for the cleanup [should] be defined based on what is necessary to protect human health and the environment from significant adverse impacts . . . cleanup should only be required in areas where an ecologically significant (not statistically significant) benefit can be shown.

Response: ENSR (1989) proposed a variation of the sediment quality goal by defining an ecologically significant benthic effects AET. This measure was defined as the occurrence of significant benthic infaunal depressions in more than one major taxonomic group (i.e., two or more depressions among Mollusca, Crustacea, and Polychaeta). The agencies had considered a similar measure during the development of approaches to sediment quality values, which was termed the "severe effects benthic AET," and was defined as the sediment concentration above which statistically significant benthic infaunal depressions occurred in more than one major taxonomic group (i.e., two or more depressions among Mollusca, Crustacea, and Polychaeta) (PTI 1989). This measure, and the ENSR (1989) measure were not considered to be adequately protective for mitigating environmental risk at the CB/NT site.

4.4.3. AET values should be adjusted to include safety factors for unmeasured chronic effects.

Response: Incorporation of safety factors to adjust AET values downward was evaluated (Tetra Tech 1986). The use of a safety factor of 10 as representative of an acute-to-chronic ratio (EPA 1985) recommended in water quality criteria guidance has also been evaluated (PTI 1989). In both cases, the number of correctly predicted stations exhibiting adverse biological effects increased slightly. However, there were a number of stations that did not exhibit significant adverse biological effects but were predicted to have adverse effects by AET that incorporated a safety factor. These stations may have exhibited chronic effects that were not measured. However, the evaluation suggested that incorporation of safety factors would reduce the ability to discern measurable effects from reference conditions and therefore safety factors were not recommended in the feasibility study or selected in the Record of Decision.

4.4.4. Large data sets are required to establish AET values and no minimum requirements for an acceptable data set for deriving AET have been established. The number and distribution of effect stations and the size and distribution of the total data set should be considered in interpreting uncertainties with AETs.

Response: Minimum requirements for deriving AETs were addressed by recommendations set forth during the refinement of AET values through incorporation of data from multiple Puget Sound studies (Barrick et al. 1988). This expanded database of approximately 330 stations from 13 embayments of Puget Sound (including Commencement Bay) was used to establish AET values that were used during the CB/NT feasibility study. It was recommended that at least 30 and preferably 50 stations be used to establish AET. However, a small number of stations that is representative of the range of chemical concentrations and biological responses in a region may be as or more effective in establishing reliable AET values as using a large database that is not representative of environmental conditions.

The effect of "weight of evidence" for different AET values based on the size and distribution of the total data set is one means of assessing uncertainty. Unquestionably, there is less uncertainty for an AET based on many observations than for an AET based on few observations. This is the reason that revised AETs based on a larger database than available during the remedial investigation, and with wide-ranging chemical concentrations, were incorporated into the feasibility study. Uncertainty ranges for AETs defined as the concentration range from two or three non-impacted stations below the AETs to one biologically impacted station above the AET have been evaluated based on statistical classification arguments (Tetra Tech 1986). The number of stations used to establish an AET (i.e., weight of evidence) could have a marked effect on this uncertainty range, because small data sets would tend to have less continuous distributions of chemical concentrations than large data sets. That is, small data sets would tend to have larger concentration gaps between stations (and correspondingly wider uncertainty ranges for AET) than larger data sets.

4.5. Comments on the Relationship of AET to Human Health

4.5.1. AET cannot address human health risk because they do not account for bioavailability of toxicants in situ and do not establish causality. AET cannot address bioavailability of chemicals in situ (although other commenters recommended that AET values for hydrophobic organic chemicals be normalized to organic carbon content to address bioavailability).

Response: AETs are not used as the sole basis for addressing human health risk in the feasibility study. A PCB bioaccumulation AET was assessed during the feasibility study but was not used as the sole method for selecting areas for remediation because of uncertainties in its derivation. The cleanup of sediment to reduce the risks to human health from the consumption of edible fish tissue was addressed using equilibrium partitioning principles. AET do address bioavailability of chemicals in sediments because AET values are established based on observed biological effects in field samples. AET normalized to the organic carbon content of sediment, presumed to be a major factor controlling the bioavailability of contaminants, have also been generated. The reliability of organic carbon-normalized AET values in correctly identifying adverse biological effects is approximately the same as that of dry-weight normalized AET values (U.S. EPA 1988). Dry-weight normalized AET values were used in assessing cleanup volumes of sediment because there was no direct evidence of an improvement in the ability to correctly predict adverse biological effects using organic-carbon normalized AET, and dry-weight normalized AET require less manipulation for application by regulators and potentially responsible parties (i.e., can be directly compared to chemical concentration data routinely reported by laboratories).

5. SOURCE LOADING ESTIMATES

Source identification and characterization (i.e., loading estimates) were performed based on historical data and data generated by sampling and monitoring during the remedial investigation/ feasibility study process. These data were used for defining source control priorities and strategies. Most of the comments received on source identification and loading were criticisms that identification and loading estimates were incorrect or inadequate and based on incorrect or insufficient data, and that loading estimates were incorrectly calculated. In addition, several commenters stated that source characterization and identification was strongly biased toward sources for which there are data available (i.e., other potentially significant sources such as nonpoint sources may be important but are poorly characterized). The majority of the comments received were from the Commencement Bay Group (including many major PRPs).

Simpson Tacoma Kraft, Washington Department of Transportation, Louisiana-Pacific, Kaiser Aluminum, General Metals, and ASARCO all commented that source data relating to their facilities and operations are outdated or inadequate for decision-making. Griffin Galbraith, Foss Maritime, General Metals, Dunlap Towing, and USG stated that nonpoint sources are inadequately characterized and may contribute significantly to contamination. Louisiana-Pacific stated that loading data are not properly calculated. The Puyallup Tribe of Indians commented that the feasibility study should present a detailed stormwater control plan.

5.1. Comments on Identification of Present and Historical Sources

5.1.1. Characterization of PCB loading is inadequate to identify sources or support remedial action.

Response: PCB source identification was noted to be incomplete in the CB/NT remedial investigation/feasibility study and the integrated action plan. Additional source identification and monitoring activities are being conducted by Ecology, as described in the Record of Decision. The implementation section of this Record of Decision emphasizes that the acceptability of source identification and control will be reevaluated before sediment remedial actions are required.

5.1.2. Existing or historical contaminant loading is inadequately characterized.

Response: The loading data limitations were stated in the remedial investigation and feasibility study. Because of these limitations, source identification was also based on known use of problem chemicals, documented historical and ongoing disposal practices, and proximity of sediment contamination to suspected source. In addition, source loading data were not used to determine the need for or effectiveness of source controls, or to develop sediment recovery scenarios, or to allocate responsibility among PRPs.

An accurate characterization of historical loading of contaminants was not possible because few studies were conducted in the past, and those studies that were conducted did not generally address contaminants of concern. Where possible, sediment core profiles were interpreted to determine if loading has increased (characterized by a broad surface sediment maxima) or decreased (characterized by a surface sediment minima).

Loading data limitations, noted early in the study, triggered a number source characterization studies. However, not all discharges are given equal weight in terms of focusing additional source identification and control activities, or conducting monitoring studies. For example, it is not considered cost-effective to monitor drains that serve small areas where historical or ongoing activities within the drainage basin are unlikely sources of problem chemicals. Similarly, it is inappropriate to sample all discharges to a waterway if there is compelling evidence indicating a probable source or sources.

5.1.3. How will new information on sources be incorporated into the decision-making process?

Response: New data collected from ongoing or future monitoring programs will be incorporated as they become available. After signature of the Record of Decision, Ecology will continue to identify CB/NT sources, select appropriate source control measures, and enforce those measures. Several factors will be considered in this evaluation including the possibility of unidentified major sources within the problem area, the status of source control for known major sources, and the possible cumulative effects from other CB/NT sources. New information on previously unidentified sources and contaminants will be evaluated by EPA during the remedial design phase and integrated into the remedial design sampling and analysis strategy for each problem area.

5.2. Comments on Adequacy of Nonpoint Sources Relative to Point Sources

5.2.1. There is inadequate consideration of non-point sources of pollution, including the potential impact of recontamination from continuing sources.

Response: This comment refers to nonpoint source contamination that is generally discharged to Commencement Bay via storm drains. Storm drains are included as potential sources to Commencement Bay and can be regulated as point sources, although they may represent contributions from nonpoint sources of contamination. However, not all storm drains are given equal weight as potential problem sources (see Response 5.1.2). The factor that street dust exceeds target cleanup levels does not indicate that urban runoff is a major source of contamination to Commencement Bay. To determine the impact of street dust (or similar material contributed by runoff) on the marine environment, several factors are considered: 1) the types of contaminants present in the street dust, 2) processes influencing the fate and transport of contaminants in street dust on the way to the marine environment, 3) the rate at which street dust (or related contaminants) are supplied to the marine environment relative to other sources of the same contaminants, and 4) the ability of the receiving environment to assimilate (or dilute and disperse) the total contaminant load. Ecology is responsible for evaluating these factors and developing permits for storm drains under the Clean Water Act and the PSWQA plan. New information from other studies regarding airborne emissions and other nonpoint sources that are not incorporated into storm drain permits will also be evaluated by the appropriate federal, state, or local agency.

5.2.2. A storm drain control plan should be developed before the Record of Decision is finalized. Without a remedial investigation/feasibility study and a Record of Decision for source control, potentially responsible parties cannot obtain CERCLA resolution of Superfund liability.

Response: For problem areas where storm drains have been identified as a significant ongoing source, storm drain control plans must be implemented before sediment remedial action can proceed. A detailed storm drain control plan can be considered an element of remedial design, and does not need to be finalized before the Record of Decision.

5.3. Comments on Loading Calculations

5.3.1. Loading calculations are incorrect and statistically invalid.

Response: Loading calculations were conducted by averaging available concentration data and flow data, and multiplying the two averages to arrive at the loading rate. The correct procedure is to first multiply data pairs, and then time average data pairs. The former procedure was applied to CB/NT data because synoptic data for concentration and flow were often not available. This simplified procedure introduces a great deal of uncertainty into the loading estimate for sources that display a great deal of temporal variability. As noted earlier (Comment 1), limitations in the loading data were clearly noted in the remedial investigation/ feasibility study. Source loading estimates will be refined during source monitoring, and the relationship of source loading to sediment accumulation will be examined in greater detail during sediment remedial design sampling.

It was noted that by not using undetected values for chemical measurements, loading calculations result in overestimates of the discharge load. This is only correct if 1) detection limits for chemicals are well below measured values, and 2) loading values from paired data that are based on detection limit values are less than loading values based on detected values. (It is assumed that paired flow and concentration data are first combined to estimate loading for discrete points in time; the correct technique described above.)

It was argued that loading data are statistically invalid because the EPA Test Method for evaluating solid waste, SW-846, suggests that the variance of the test data should be less than the average mean concentration. This guideline, while appropriate for solid waste, may not be appropriate for storm drain sampling programs where extreme amounts of data would have to be collected to characterize the highly variable flow and loading conditions. However, EPA and the state encourage the collection of comprehensive loading data where resources permit.

5.3.2. There are problems with the source loading database, especially at concentrations below EPA method detection limits.

Response: Data reported at levels below EPA method detection limits may or may not be incorrect. Modified analytical techniques are sometimes used to quantify below these limits based on specific project requirements. Such modifications are typically documented in sampling and analysis plans and quality assurance project plans. However, in some cases, particularly with older data sets, false positive values are of concern. In these cases, source loading data should not and will not be used a the sole basis for identifying a potential source. Rather, chemical usage and disposal practices will be evaluated.

6. SOURCE CONTROL

Source control and sediment remediation are two key components of site cleanup. Source control is important for preventing ongoing degradation, enabling natural recovery, and preventing recontamination of remediated areas. Comments received on source control focused on three themes: the emphasis placed on source control, the feasibility and effectiveness of source control, and source loading estimates.

TPCHD, the Washington Department of Natural Resources, and Puget Sound Plywood commented that the feasibility study should place more emphasis on source control and the PSWQA stated that the integrated action plan should address spills and spill prevention. The Tacoma-Pierce County Chamber of Commerce expressed concern over the fact that areas outside the CB/NT site are not addressed and should be monitored by EPA and Ecology. The Puyallup Tribe of Indians stated that source control should be implemented immediately and considers the feasibility study inadequate to assess source control needs.

6.1. Comments on the Appropriateness of Source Control

6.1.1. A systematic look at all sources, their contribution, degree of achievable control, and priority for control, should be defined. The framework for such a plan should be established prior to the Record of Decision.

Response: Source control is considered a key element of the site remedy; source control efforts to be conducted by the Commencement Bay UBAT has been enhanced through a Cooperative Agreement between EPA and Ecology. Control of major sources of problem chemicals to a level that utilizes all known available and reasonable methods of technologies (AKARTs) is required before sediment remedial action is scheduled to proceed. Source control at the CB/NT site is a complex process because of the large variety of sources, the various status of sources (i.e., historical, ongoing, increasing, decreasing), and the changing institutional structure of environmental standards and requirements. Consequently, source control is addressed through a variety of programs that are either being implemented by Ecology or coordinated with Ecology's Commencement Bay UBAT to ensure consistency with the objectives of the CB/NT project. These programs are described in greater detail in Section 3 of the Decision Summary and in the integrated action plan (PTI 1988) of the CB/NT feasibility study.

The feasibility study focused on sediment remedial action but source control was also integrated into the overall process. General response actions for various types of source control were described, feasible levels of source control were estimated, and enhanced regulation and control of significant sources was described as a key element of all CB/NT remedial alternatives, except the No Action alternative. More specific information regarding the status and nature of major sources in each CB/NT problem area was also described. The integrated action plan was developed as a framework for scheduling and planning both source control and sediment remedial action at the CB/NT site. The timetables outlined in the integrated action plan are intended to be updated on a regular basis to reflect changes as overall project implementation proceeds. Details of source control strategies, including specific remedial technologies, are available in the various individual facility or source studies. In general, such controls require AKARTs to all point sources and rigorous application of best management practices to nonpoint sources.

6.2. Comments on Remedial Technologies for Source Control

6.2.1. The feasibility study proposes infeasible end-of-pipe source control measures. A more detailed cost evaluation for individual source control measures should be presented.

Response: Source control estimates are based on existing compliance and inspection schedules as well as the best professional judgement of Ecology experts responsible for implementation of source control, and as such are adequate for planning purposes and prioritization of both sources and sediment remedial action planning. The agencies recognize that 1) source control measures must be evaluated more closely on a property-specific basis, 2) compliance schedules must also be developed on a source-by-source basis, and 3) sediment remediation cannot proceed until adequate source control is achieved.

6.3. Comments on Relating Source Control to Sediment Quality Objectives

6.3.1. The agencies first objective should be to control existing sources of pollution in Commencement Bay before requiring that industry, the city, the port, and landowners invest large sums of money in sediment remedial action.

Response: Sediment remedial action will not be implemented until source monitoring confirms that major sources have been controlled to the extent that sediment recontamination is not predicted to occur, or that the source is in compliance with AKART requirements. This determination will be made by Ecology and EPA. There may be facilities which, after implementation of AKART, continue to discharge contaminants at levels that will exceed sediment cleanup objectives in the vicinity of the source. For these facilities, a waiver will be incorporated into applicable permits to allow a temporary sediment impact zone with specified requirements for monitoring and closure.

6.4. Comments on Appropriateness of Feasibility Estimates for Source Control

6.4.1. The feasibility study overestimated the feasibility and effectiveness of source control measures.

Response: The percentage reductions estimated to be feasible were intended to be extremely rough estimates (see responses in Section 5.3). Most assumptions are conservative. For example, the reduction in HPAH release already attained by Kaiser Aluminum probably represents greater than the 90 percent reduction (relative to an assumed steady state with existing surface contamination) that was estimated to be feasible in the feasibility study. However, the effectiveness of source controls will be reevaluated during source monitoring and remedial design. For some waterways, conservative estimates of the rate of natural recovery provided in the feasibility study will be adjusted with new data and will likely have the effect of decreasing the areas or sediment volumes that will require remedial action.

6.4.2. Source control estimates in the feasibility study are based on technically unsupportable assumptions.

Response: The source control estimates developed during the feasibility study cannot be considered guidelines for source control. These estimates were developed to estimate the relative importance of source control and natural recovery, and to estimate the cost benefits associated with the consideration of natural recovery. It was necessary to use this extremely simplistic approach to estimating source control because source loading data were inadequate (see responses in Section 5.3). Specific requirements for source control, including the relationship of source loading to sediment accumulation and the role of sediment impact zones, are currently being developed by Ecology, and will be in place before sediment remedial action takes place.

6.5. Comments on the Status of Source Control

6.5.1. Recent activities and loading data indicate that many sources are controlled.

Response: It is recognized that source controls have been implemented and that their success has been documented at several facilities. This will be confirmed on the basis of source loading analyses conducted before sediment remedial design.

7. NATURAL RECOVERY AND THE SEDIMENT CONTAMINANT ASSESSMENT MODEL

The Sediment Contaminant Assessment Model (SEDCAM) was developed and applied to CB/NT problem areas to describe the relationship between source loading and sediment accumulation of problem chemicals, and to estimate the relative importance of natural recovery. Comments on SEDCAM related primarily to the model's simplifying assumptions and its lack of field verification. The Puyallup Tribe of Indians commented that SEDCAM will overestimate recovery rates because assumptions about source control. However, most commenters (primarily PRPs) stated that SEDCAM would underestimate recovery. Louisiana-Pacific, Port of Tacoma, and NOAA expressed concern over model uncertainty, the limitations to the use of the model because of inherent assumptions, and the lack of field verification.

7.1. Comments on the Protectiveness of Natural Recovery

7.1.1. Natural recovery is de facto in situ capping, but in situ capping was rejected as an alternative in all waterways but St. Paul because of the high likelihood that the sediments in all of the other waterways would be dredged for maintenance or new construction.

Response: *In situ* capping was not rejected; in fact, the selected alternative identified in the Record of Decision broadly defines sediment confinement to include *in situ* capping. In natural recovery areas that may require maintenance dredging, the dredging and dredged material disposal would be regulated by Clean Water Act Sections 401 and 404 (i.e., the state water quality certification process), Washington Department of Fisheries and Washington Department of Wildlife (hydraulics permits), Washington Department of Natural Resources (aquatic disposal site permits), city of Tacoma (shoreline substantial development permits), and PSDDA (procedures and guidelines for dredged material and disposal site testing). Routine navigational dredging actions must meet all substantive and procedural requirements of these permit and certification programs.

7.1.2. The proposed natural recovery is simply a slow form of dilution. The same result, without the delay and uncertainty of recovery, would occur by allowing in situ capping.

Response: In marginally contaminated areas, natural accumulation of cleaner sediment that would result in recovery over a reasonable time period was preferred to the potential adverse impacts of sediment confinement operations (e.g., burial of existing benthic communities). Natural recovery increases the feasibility of sediment remedial action by enabling resources to be focused on more highly contaminated areas, and by reducing overall costs.

7.1.3. Natural recovery should be the preferred alternative except in cases where it plainly will not protect human health and the environment in the long term.

Response: Natural recovery has been determined by EPA and Ecology to be appropriate in marginally contaminated areas, because recovery can occur in a reasonable time period following source control. In more heavily contaminated areas, the predicted persistence of significant adverse impacts over long periods of time outweighs the potential short-term impacts from active remediation; therefore, sediment remediation is warranted in order to be adequately protective of human health and the environment.

7.2. Comments on Modeling Predictions Using SEDCAM

7.2.1. Simplifying assumptions limit the utility of the model.

Response: The simplicity of the model, and the additional simplifying assumptions that were incorporated into its application reflect the data limitations noted earlier for source loading. Sedimentation rate, depth of the mixed layer, and chemical-specific degradation (or loss) rates (simulated as a first order process) are also poorly known. Further refinements both to the model formulation (e.g., simulation of sediment mixing with an eddy diffusion coefficient, inclusion of enhanced exchange with overlying water during sediment resuspension, formulation of a time-variable input function) and to its application (e.g., use of recently collected loading data that had undergone comprehensive data validation) will occur during source monitoring and sediment remedial design.

7.2.2. Too many conservative assumptions are included in the application of SEDCAM.

Response: In the absence of adequate data, conservative assumptions were applied. It should be noted that the assumption of a 10-cm thick mixed layer translates to a comparatively nonprotective (i.e., non-conservative) cap thickness. That is, surface sediments that undergo natural recovery are considered to have attained the long term objective when chemical concentrations in the mixed layer (upper 10-cm) meet long-term objectives; however, sediments that are not predicted to undergo sufficient recovery in a reasonable time frame are subject to burial with a 3- to 6-foot layer of clean sediments.

7.2.3. Insufficient and unreliable model input data from Commencement Bay has resulted in recovery times that may be several times longer (some commenters claim shorter) than actual recovery times. SEDCAM has not been field tested.

Response: Confirmation of model predictions with sediment monitoring data is a required element of the site remedy. Predictions regarding the effects of source control and natural recovery which were developed during the feasibility study must be refined based on new data obtained during source monitoring and sediment remedial design sampling.

7.2.4. The SEDCAM application to the Head of City Waterway used erroneous data. A sedimentation rate of 600 mg/cm^2/yr is used instead of the value of 1,760 mg/cm^2/yr indicated by the ^{210}Pb data.

Response: The commenter indicated that depth changes since last dredging indicates a sedimentation rate of 3.0-3.7 cm/yr instead of the 1.26 cm/yr indicated by ^{210}Pb or the value of 0.43 cm/yr used in the feasibility study. A lower sedimentation rate was used because existing information on the loading rate of material from the two major drains at the head of the waterway indicated much greater discharges of particulate material in the past. This change in sediment accumulation confounds interpretations of ^{210}Pb data, because the ^{210}Pb dating model assumes constant sediment accumulation (on the average) over the time period that is being dated. Similarly, if the average sedimentation rate was used (on the basis of the dredging horizon), the sedimentation rate would also be greatly overestimated.

8. SEDIMENT REMEDIAL ALTERNATIVES

Sediment remediation is one of the major components of the site cleanup. Comments regarding remedial alternatives included discussion of evaluation criteria used in the feasibility study, the feasibility and impacts of dredging, natural recovery, and monitoring requirements. Most of the comments were made by the major PRPs, both individually and together (as the Commencement Bay Group). In general, comments of the PRPs questioned the need for, and feasibility of, remedial actions.

8.1 Comments on the Permanence of Confinement Options

8.1.1 The feasibility study is clear in recognizing that none of the confinement options meet the SARA preference for a permanent solution.

Response: The remedy selected in this Record of Decision is intended to provide a permanent solution to CB/NT sediment problems. (See response to Comment 1.1.1 and further discussion in Section 11.4 of the Decision Summary regarding differences between permanent solutions and utilization of permanent treatment technologies.)

8.2 Comments on the Feasibility of Confinement Options

8.2.1. The feasibility study does not identify feasible and cost-effective disposal sites. Site-specific data are not detailed enough to identify the disposal site capacity needed and available. Disposal site bathymetry, calculated capacity, diking configuration and volume, and other geotechnical considerations are required evaluation criteria instead of specifying an unidentified upland site within a 3-mile radius.

Response: The assessment of disposal site availability will change depending on changes in alternative uses of the site and estimates of total volumes of material to be dredged as part of sediment removal action. The selected remedy includes a suite of containment options which include some with definite disposal site availability (e.g., confined aquatic disposal in waterways). All of the candidate sites in the feasibility study are located near the problem areas and represent near-minimum transportation costs. Final selection of a disposal site for each problem area is most appropriately decided during remedial design when more accurate data on sediment volumes are available.

8.2.2. The proposed remedy does not adequately take into account the lack of suitable, available onsite disposal capacity.

Response: The selected remedy includes a suite of containment options which include some with built-in disposal site availability. The options are considered equally protective and feasible. EPA recognizes that the containment option selected for each waterway will force certain economic/development choices by PRPs. The agencies do not see the need to specify disposal sites in the Record of Decision.

8.2.3. Blair Waterway Slip 1 is not available for nearshore disposal or of inadequate capacity. The Wheeler Osgood waterway, the St. Paul Waterway, and the Hylebos Disposal Site #1 are suggested as alternative sites.

Response: The comment noted that volumes cited in the feasibility study are various and overestimated even presuming a vertical wall at the outer end of the slip. A vertical wall is unreasonable, and construction of a berm would further reduce slip capacity. Capacity is estimated to be 590,000 cubic yards for a 55-foot fill and 347,000 cubic yards for a 30-foot fill. Changes in the Port of Tacoma's intended use of Slip 1 have occurred since the collection of data for the feasibility study, and it is uncertain whether this site will be available for nearshore disposal.

Nearshore disposal has been included as one of the four confinement options within the selected remedy. As a general policy for the CB/NT site, EPA would prefer that the nearshore disposal option only be utilized in conjunction with projects that would otherwise be permitted commerical development. The intent of this policy is to minimize unnecessary impact to nearshore habitat, consistent with the provisions of the Clean Water Act Section 404. Therefore, the use of these other areas as potential nearshore disposal sites would be limited according to the CB/NT policy to minimize impact to intertidal and nearshore areas.

8.2.4. The feasibility study incorporates unrealistic goals of clean sediment availability. An estimate of the quantity of capping material needed and available should be made.

Response: The volume of clean sediment required varies with the alternative. For *in situ* capping, the entire problem area must be covered with a cap of 3-6 feet in depth, or a total of 792,000-1,548,000 cubic yards. For nearshore and upland disposal, only the intertidal area must be capped (for habitat mitigation), requiring a total of 32,000-64,000 cubic yards. For in-waterway CAD, overdredged sediment will be used for capping.

8.2.5. Use of deep-water CAD is unproven, and experience suggests it will not reliably eliminate exposure of biota to toxics.

Response: Although deep-water CAD sites have effectively been used in other sites, it is not included in the selected remedy for the CB/NT site.

8.2.6. Specification of the use of new technologies in St. Paul Waterway, for which the preferred alternative is natural recovery, is not appropriate, and should not be included in the Record of Decision.

Response: No such technology is specified in the selected remedy. The remedial action undertaken in the St. Paul Waterway area by Simpson Tacoma Kraft included containment of contaminated sediments behind a berm, capping with clean material, and habitat restoration.

The proposed plan was reviewed by appropriate agencies and was implemented in a timely manner. The benefits of timely remediation, habitat restoration, and an engineered cap design that will be monitored outweighed any concerns for the use of remedial technologies over natural recovery.

8.2.7. The Record of Decision should acknowledge that the preferred alternative for St. Paul waterway (source control, a new outfall, and remedial action) has been successfully implemented.

Response: The comment is noted. The Record of Decision includes a description of cleanup activities completed in St. Paul Waterway.

8.2.8. The feasibility study did not identify feasible dredging technology for the Ruston-Pt. Defiance Shoreline.

Response: The Ruston-Pt. Defiance Shoreline has been removed from the list of problem areas to be addressed by this Record of Decision.

8.2.9. Some areas to be dredged are under piers; the feasibility study does not identify feasible or cost-effective remediation techniques for these and other obstructed areas. The comment noted that the side slopes of Sitcum Waterway are covered with riprap; alternatives for removal are costly and pose a risk to existing pier structures.

Response: The extent of contamination of each problem area will be further evaluated during sediment remedial design. If sediment problems are indicated in areas such as side slopes, under piers, and in other obstructed areas, special remediation techniques may have to be developed to meet the performance-based criteria. Alternative technologies, including those not commonly used in Puget Sound, such as mud cats, may be applied in pier areas; *in situ* capping may also be selected as an alternative to sediment removal. However, remedial action in areas covered with riprap is unlikely except perhaps if it is a component of a source control action.

8.2.10. The feasibility study does not identify feasible or cost effective remedial alternatives for the head of Hylebos Waterway. The feasibility study recommended dredging and confined aquatic disposal at the mouth of the waterway, and dredging and nearshore disposal for the head, at approximately 3 times the estimated cost of confined aquatic disposal.

Response: The selected remedy has been modified to address such concerns. The remedy selected in this Record of Decision specifies a range of containment options as the sediment remedial action element rather than specifying a performance-based remedy or a single containment alternative.

8.3 Comments on the Impacts of Dredging and Disposal

8.3.1. Remedial dredging destroys benthic habitat, resuspends sediment, and releases toxins.

Response: Remedial dredging is to be conducted in areas in which the habitat has already been degraded beyond its ability to support a healthy benthic community as measured by objective statistical analysis of *in situ* abundances of benthic macroinvertebrates. In-waterway confined aquatic disposal will result in the disturbance and burial of existing communities, but the clean material to be used for capping will provide habitat for the reestablishment of a healthy benthic community. Use of a modified, watertight clamshell dredge and a hydraulic dredge will reduce resuspension of sediments and release of toxics to the maximum extent practicable.

8.3.2. Nearshore disposal must adhere to the policy of no net loss of wetland habitat.

Response: Nearshore disposal has been adopted as one option for confinement. The selection of an appropriate nearshore disposal site (if appropriate), and the protection of wetland habitat, must be considered during the remedial design for each problem area. Nearshore disposal is only considered appropriate if it can be incorporated with an approved development project.

8.3.3. Concentration data used for establishing preferred alternatives (particularly for the turning basin at the head of Hylebos) are outdated immediately by the bottom disturbance caused by vessels.

Response: The proximity of sediment contamination to suspected or identified sources suggests that sediment reworking does not disperse contaminated sediment over large geographic areas. Sediment sampling during remedial design will determine the extent of sediment redistribution at the head of Hylebos Waterway. This effort will include sampling at depth in sediment cores to characterize the entire volume of material requiring remediation.

8.4. Comments on Cost and Volume Estimates

8.4.1. The feasibility study consistently underestimates costs as a result of underestimating the sediment volumes due to swelling and overdredging; underestimation of unit costs for dredging, transportation, and disposal; omission of costs for habitat mitigation, water column monitoring, site preparation, mobilization/demobilization costs related to equipment type, and predesign sediment monitoring; underestimation of monitoring costs; omission of source control costs; omission of economic costs of dredging in active waterways, and omission of economic costs of limitations on use of nearshore areas due to structural composition of dredge spoil.

Response: Several commenters presented alternative site-specific costs for the problem areas, with a total cost almost three times as high as in the feasibility study. Revised cost estimates were conducted for the four confinement options selected in the Record of Decision, and are presented in Section 10.4 of the main text.

8.4.2. Dredging volumes specified in the feasibility study are underestimated. The need for overdredging to excavate to the depths specified in the feasibility study will increase dredged material volume. Swelling, spreading, and mounding of dredged material will also increase the volume of material to be disposed.

Response: Volume estimates were based on a four-foot dredging lift. As contaminated sediments are generally confined to the upper one to three feet, volume calculations based on the removal of a four-foot lift incorporates an overdredging allowance. Swelling of sediments is an effect not accounted for in the comparison of alternatives and preliminary cost analysis presented in the feasibility study. Swelling has its principal effect on transportation cost; sediments are expected to recompact upon disposal. Alternative volume estimates presented by commenters neglected sediment recompaction. This was accounted for in the revised cost estimates provided in the Record of Decision. The actual extent (and thus volume) of each problem area will have to be further refined during remedial design, based on additional sampling.

8.4.3. The bottom topography of the confined aquatic disposal site is sloping rather than flat, and diking may not be feasible. Dike construction may consume most of the stated capacity of the confined aquatic disposal site.

Response: New information regarding the Brown's Point confined aquatic disposal site proposed in the feasibility study does suggest that it would be unsuitable. Use of the Brown's Point confined aquatic disposal site, however, is not among the preferred alternatives identified in the final Record of Decision due to concerns regarding the ability to accurately place and monitor contaminated sediments at great depth, and due to conflicts with the CERCLA preference to avoid offsite disposal of untreated wastes.

8.5 Comments on the Cost-Effectiveness of Sediment Remedial Action

8.5.1. The performance-based Record of Decision must identify feasible and cost-effective remedial actions, not simply specify cleanup standards.

Response: Although based on performance objectives, the CB/NT Record of Decision specifies confinement as the preferred disposal alternative for contaminated sediments, including four options (i.e., *in situ* capping, confined aquatic disposal, nearshore disposal, and upland disposal). Each of these options has proven feasible and cost-effective at other sites. The inclusion of disposal options in the Record of Decision allows PRPs to select the most appropriate disposal strategy for each problem area. Records of decision have been issued in other circumstances (e.g., the Colbert Landfill site in Colbert, Washington) that allow flexibility in the remedial design/remedial action phase.

8.5.2. According to EPA's figures, confined aquatic disposal is about 1/3 the cost of nearshore disposal and much more likely to be feasible, given the lack of nearshore disposal sites. Therefore, confined aquatic disposal is more cost-effective than nearshore disposal.

Response: The Record of Decision specifies four confinement options for remediation of contaminated sediments and thus allows flexibility in selecting the most appropriate option for each problem area. As the commenter notes, cost and availability of disposal sites will be key factors in this selection process.

8.5.3. The benefits of remedial action have not been clearly identified and demonstrated to exceed the costs.

Response: CERCLA does not mandate that individual remedial actions be selected based on the result of a cost-benefit analysis; a consensus on assignment of monetary values to environmental quality and human health is impossible to achieve. Cost is merely a balancing criterion for consideration of remedies that are otherwise equally protective of human health and the environment.

9. IMPLEMENTATION AND MONITORING

A number of comments were received on the process for implementing key elements of the selected remedy, particularly source and sediment monitoring. Comments on these topics were received from various PRPs, and federal and state agencies. Comments generally addressed the timing and suitability of the 10-year recovery period, the role of routine dredging, and the process for implementing monitoring programs and interpreting monitoring data.

9.1 Comments on Timing of Source Control, Sediment Remedial Action, and Natural Recovery

9.1.1. Stormwater drains and other nonpoint sources of pollution are not identified or will not be controlled until after other sources, and therefore sediment remediation will not be effective. The obligation for stormwater source control must be established by the Record of Decision.

Response: Stormwater drains have been identified, and a monitoring program administered by Ecology is to identify those to which source control shall be applied. Details of the source control element are described in the response to Comments 6.1.1 and 6.2.1. Sediment remediation in a problem area cannot proceed until adequate source control is achieved in that problem area.

9.1.2. The 10-year period for natural recovery appears to be arbitrary and unjustified.

Response: The remediation of all sediments in the CB/NT site with contaminant concentrations at or above the cleanup goals was considered inappropriate because remediation of all such sediments may result in more environmental disruption (through dredging and capping activities) than might be expected if some of the less contaminated sediments were allowed to recover naturally. In addition, the cost of remediating marginally contaminated areas could not be justified in all cases. To achieve a balance between protection of human health and the environment, and cost-effectiveness, the feasibility study employed a sediment recovery model (SEDCAM) to define areas of the CB/NT site that would be expected to recover within a 10-year period.

Many commenters suggested alternative natural recovery periods, ranging from 2 to 25 years. Some suggested that natural recovery should be allowed to proceed for 10 or more years even in the most highly contaminated areas before remedial action is undertaken. The 10-year recovery period was selected by Ecology and EPA to define areas requiring sediment remediation. The 10-year recovery period was selected based on assumptions about source control, the rate of accumulation of new sediment, and the degree of mixing of old and new sediment because of burrowing organisms and physical processes. Control of all priority sources in the CB/NT site is planned according to the implementation schedules in Appendix C. Maximum environmental and human health benefit will be derived in a cost-effective manner by remediating the most contaminated sediment sites first, because of the time required for full implementation of source control. The results of the SEDCAM modeling indicate that some sediments will recover naturally during a 10-year period, and therefore, do not warrant further disruption by sediment remedial action. Such actions would also be less cost-effective in the short-term. Sediment monitoring will be implemented to verify the results of SEDCAM modeling. The results of modeling will be periodically evaluated to determine the status of sediment recovery and the potential need for additional source control measures or sediment remediation.

9.2. Comments on Time Schedules

9.2.1. Timetables for remedial action do not give an adequate allowance for the completion of source control.

Response: Updated versions of the implementation schedules presented in the integrated action plan (PTI 1988) are provided in Appendix C. Schedules have been revised to reflect more recent information on the status of source identification and control activities. These schedules were developed for planning purposes, and depend on continuing resource availability, successful negotiations with PRPs, and timely implementation of source control.

9.2.2 Comments on the draft feasibility study are far reaching and cannot truly be adequately addressed and responded to in just a few months (i.e., by summer or early fall of 1989).

Response: The agencies have reviewed and considered all comments. All comments that were considered germane to the selection of remedy have been summarized and responded to in this Responsiveness Summary. Other comments that were not germane to the selection of the remedy but that may be important for remedial design, remedial action, or additional source control are summarized in Section IV and are listed in the annotated bibliography in Section V.

9.2.3 When the proposed 10-year clock for natural remediation starts is not clearly stated. It is essential that the sequence of all events be clearly established.

Response: The beginning of the 10-year time period for natural recovery will coincide with implementation of sediment remedial actions, which will begin after control of major sources as described in Comment 6.3.1. For problem areas where the entire area of sediment exceeding sediment quality objectives is predicted to recovery naturally in 10 years, the recovery period will begin after the baseline monitoring program (which may correspond to remedial design sampling). Adequate recovery in natural recovery areas is to be confirmed by biological and chemical testing as part of required monitoring. If the agencies determine from these monitoring data that adequate recovery has not occurred in the designated timeframe, then remediation may be required even if the area was originally predicted to recovery naturally.

9.2.4. Further testing and evaluation is mandated to identify and quantify "toxic hot spots" before implementing remedial action.

Response: Refinement of the areal extent and severity of contamination will be refined during remedial design sampling.

9.3. Comments on Routine Dredging Projects

9.3.1. Maintenance and development dredged material which passes PSDDA requirements should be allowed to go to the PSDDA disposal sites.

Response: This comment assumes separation of sediment into suitable and unsuitable categories for open-water disposal by applying PSDDA testing methods. It is recognized that clamshell dredges have a horizontal accuracy sufficient to maintain separation of sediments. Maintenance and development dredging waste is allowed at PSDDA sites if it meets PSDDA disposal guidelines for open-water unconfined disposal. CERCLA actions do not cover routine maintenance dredging activities.

9.3.2. Maintenance dredging may remove contaminated sediment, making remedial dredging unnecessary.

Response: Feasibility and cost analyses have been prepared presuming that all sediments in problem areas, even those in channels that may be subject to maintenance dredging, will be removed by remedial action dredging. As the extent and schedule of maintenance dredging is unknown, this is a conservative assumption, and allows planning for worst-case remedial actions. It is not likely that maintenance dredging will make remedial dredging unnecessary, because for the eight CB/NT problem areas described in this Record of Decision, any material that is not predicted to recover naturally and that does not pass PSDDA guidelines for open-water unconfined disposal, will be remediated as part of a Superfund action.

9.3.3. Additional volumes of contaminated material and disposal options have not been recognized for maintenance and development dredging that may occur in some areas designated for natural recovery.

Response: CERCLA actions do not cover maintenance dredging. Contaminated sediments encountered during remedial dredging must be disposed of in accordance with PSDDA or other applicable guidelines.

9.4. Comments on Source Monitoring

9.4.1. Washington Department of Transportation has performed remediation and monitoring of tar and copper bordering City Waterway and should not be listed as a PRP.

Response: Runoff from Interstate-5 is the primary source of contamination of concern relative to Washington Department of Transportation, not the contaminants uncovered and removed during construction of the Tacoma Spur.

9.4.2. The Washington Department of Transportation and the state of Washington should be listed as PRPs, based on an estimate that Interstate-5 contributes about 40 percent of the pollution entering Commencement Bay.

Response: This comment is being considered by EPA in its PRP search.

9.4.3. The feasibility study does not acknowledge the efficiency of the management practices, including source control, remedial actions, and implementation of secondary treatment that have already been implemented at the ore handling facilities on Sitcum Waterway and Kraft mill on St. Paul Waterway.

Response: The feasibility study focused on sediment remedial alternatives for the nine problem areas. The integrated action plan provided a general description of source control actions still needed at major sources, but it was not intended to provide a detailed history of source control actions at each facility. It is the responsibility of Ecology to track environmental management activities at each facility, to review past actions, to determine what additional source control measures are necessary, and to see that those additional measures are implemented.

9.4.4. Developing state policy indicates that a sediment impact zone may be designated for sources that are implementing AKART, but are unable to meet sediment criteria without unreasonable cost. The feasibility study should address: 1) How the decision to require (or not require a sediment impact zone will be made; 2) What technical bases are to be used to define the area of a sediment impact zone; 3) What effect will a sediment impact zone have on the long term timing of sediment remedial actions; 4) What monitoring of a sediment impact zone will be required; 5) What long term remedial actions will be required where a sediment impact zone is established; 6) What parties will be responsible for monitoring and, in essence, stand behind the sediment impact zone.

Response: Guidelines for the development, operation, and closure of a sediment impact zone are being developed by Ecology. The sediment impact zone policy will be recognized in the evaluation of the acceptability of source controls that is conducted prior to implementing sediment remediation. If the continued discharge resulting in sediment contamination is clearly in the public interest, a wastewater discharge permit may define a specific sediment impact zone for the discharge, and require periodic maintenance until better methods of treatment can be identified and implemented. This permit] would not likely delay capping or dredging contaminated sediments because such cleanup actions provide a clean baseline for monitoring the discharge.

9.5. Comments on Sediment Monitoring

9.5.1. Location of a confined aquatic disposal site in Commencement Bay must take into account PSDDA siting considerations and monitoring.

Response: The selection of in-waterway confined aquatic disposal as the preferred alternative will not conflict with the PSDDA disposal site or monitoring locations.

9.5.2. Monitoring of newly exposed sediment following dredging should not be done unless there is an expectation that the new surface will be toxic.

Response: Monitoring of the newly exposed surface is intended to characterize the completeness of the cleanup and establish a basis for later determining whether natural recovery or recontamination is taking place, and if habitat restoration is successful.

9.5.3. Monitoring of the newly exposed sediment should be done, but by a surface grab sample taken immediately after dredging rather than by a core; this will be a considerable cost savings.

Response: The newly exposed surface is expected to be subject to mixing with deeper sediments, both as a result of bioturbation and physical disturbance. A core taken after dredging will indicate whether there is subsurface contamination that may be brought to the surface, and will provide a basis for interpretation of long-term monitoring data.

9.5.4. Monitoring of sediments not clearly exhibiting benthic toxicity is recommended at five and 10 years following source control. Monitoring following cleanup must be required..

Response: Monitoring requirements are discussed in Section 10 of the Decision Summary and in the integrated action plan (PTI 1988). Monitoring is required after source control and any sediment remedial action to demonstrate the effective remediation of problem areas and integrity of disposal sites.

9.5.5. Confined aquatic disposal sites are experimental and therefore require more compliance and environmental monitoring than stated in the feasibility study.

Response: Confined aquatic disposal site monitoring is briefly outlined in the integrated action plan. Specific monitoring plans for each site will be developed during the remedial design phase.

IV. REMAINING ISSUES

Some issues and concerns were raised that were not germane to the selection of remedy but which do warrant consideration by the agencies. These issues are marked as "Deferred" and will be considered and factored into remedial design and action. These issues and concerns included:

1. Incorporation of new information developed post-record of decision as described in Section 10.3 of the Record of Decision and briefly discussed in the response to Comment 5.1.3

2. Success of future source control and the impact on remedial action plans; the success of source control will be monitored and adequate source control will be required before sediment remedial action begins

3. Future public input to the integrated action plan, which will be through participation in the Technical Discussion Group and public comment periods on individual consent decrees that implement specific cleanup plans

4. ASARCO's comments specific to sediments in the Ruston-Pt. Defiance problem area, which will be considered public comments for the new ASARCO sediments operable unit

5. Other detailed comments that are relevant to remedial design considerations (i.e., specific comments on the area, volume, and characteristics of contaminated sediments); these comments were not relevant to the selection of remedy but will be further considered at the start of remedial design.

V. ANNOTATED BIBLIOGRAPHY

Comments abstracted from materials submitted by citizens, and representatives of various agencies, PRPs, and citizen groups are summarized in this section. Additional detailed comments were submitted during the comment period as part of major documents, such as ENSR (1989), Kaiser Aluminum and Chemical Corporation (1989), Pennwalt Corporation (1989), Puyallup Tribe of Indians (1989), and ASARCO (1989). These comments were considered in developing responses to the major summary comments that were identified in these reports and listed in this section.

AOL Express, Inc. (1989)

See Response 3.3.1	*[W]e feel it is important that consideration be given to the level of cleanup, taking into account the multiple use nature of the area and the importance of a healthy local economy.*
See Response 6.1.1 and 8.2.1	*We feel that with effective source control monitoring and the availability of an adjacent disposal site, a reasonable and cost-effective remedy can be achieved.*
Deferred	*The public storm drains in our area drain into the "Blair" waterway, a site not designated for any cleanup action...we support [the position to have "responsible parties" do the cleanup], but strongly maintain that we are not a responsible party [in the Hylebos Waterway]. The best way to deal equitably with the smaller business who is demonstratively not involved in pollution of the waterway is to enter into immediate negotiations for release either by outright dismissal or deminimis settlement.*

ASARCO (1989)

See Response 1.1.3	*The Feasibility Study has failed to comply with the NCP in that it is too broad [comprising the entire bay] and is based upon inadequate data [for any given segment of the bay]. Based upon the [recent] findings of [the Tacoma Smelter site RI/FS], EPA should withdraw in its entirety that portion of the Commencement Bay FS dealing with the area offshore of the Tacoma smelter and should revise the FS based upon the data.*
See Response 3.3.1	*The Feasibility Study is based upon an improper remedial action goal . . the sediment quality goal, "no acute or chronic adverse effects on biological resources or significant health risk to humans" . . . is unconnected with any requirement of CERCLA and is not mandated by any ARAR . . . [the goal] far exceeds CERCLA's goal of protecting the environment . . . and is not attainable [as a clean up objective. A goal of sediment quality that supports a properly functioning in situ benthic community and does not pose a significant risk to human health, is attainable and much more in keeping with the stated statutory objectives of CERCLA.*
See Response 6.1.1 and 6.3.1	*Appropriate source control should be undertaken and achieved before any offshore remedial action.*
See Response 7.2.3	*The impact of natural recovery processes have been greatly underestimated by Tetra Tech. Once onshore source control has been attained [at the Asarco Tacoma Smelter], it is highly likely that physical removal of contaminated*

sediments by currents and wave action will be achieved. This activity was not properly considered by the FS.

See Response 1.1.5	*The FS has failed to take into consideration the fact that much of the contamination targeted for remedial action [at the Asarco Tacoma Smelter] is a result of a "federally permitted release" and therefore not actionable under CERCLA. . . At a minimum, the FS should consider the impact of federally permitted releases and exclude contamination from such releases from any remedial action recommended or set up the proper method for crediting the PRP for such releases.*
See Response 8.3.1	*The FS alternative for the area offshore of the Asarco Tacoma Smelter is contrary to the objectives of CERCLA [because it . . .] contains a healthy, and in some cases, very unique benthic community . . . extensive dredging is not only unnecessary, but would itself adversely impact the environment through total destruction of health benthic communities.*

[Numerous specific comments followed in the comment letter that pertained to the Asarco Tacoma Smelter site; attachments included a "Review of Commencement Bay Feasibility Study" by Parametrix, Inc. and Black & Veatch, "review of Commencement Bay Integrated Action Plan" by Parametrix, Inc., "Review of 13.0 Ruston-Pt. Defiance Shoreline Commencement Bay Feasibility Study" by Parametrix, Inc., and "Technical Review of the Apparent Effects Threshold Approach" by Tetra Tech, Inc., and the "Asarco Tacoma Smelter Remedial Investigation" by Parametrix, Inc. (1989).]

American Savings Bank (1989)

Deferred	*[O]bjects to its designation as a potentially responsible party . . . [and] reserves the right to comment further when [the Proposed Plan] is completed.*

Buffelen Woodworking Company (1989)

See Response 6.1.1 and 6.3.1	*We agree with EPA that the priority should be to work with the responsible parties to ensure that source control is complete before starting sediment remediation.*
See Response 8.2.3	*The EPA should consider alternatives to the Port of Tacoma Slip #1 on the Blair Waterway. Comments . . . indicate that the Port needs the use of this site before clean-up can reasonably expect to be completed.*
See Response 1.1.6	*We disagree with the method the EPA has for assessing costs against the PRP's as an aggregate group rather than on an individual basis. This method can result in the PRP with the most effective attorney being responsible for the smallest percentage of the cost. . .*

Champion International (1989)

See Response 8.2.7	*In view of the fact that [the clean-up of St. Paul Waterway as outlined in the Consent Decree] has been completed and has been judged to be successful, Champion urges EPA to accept the project as completed in the ROD for the Commencement Bay site. Champion agrees with the FS conclusion as set forth in [Section 8.6] that in situ capping of the problem area of St. Paul Waterway is the preferred alternative. The ROD should accept this recommendation.*

Information noted	*[The St. Paul] project was completed under Ecology supervision and with EPA being kept fully informed of the nature of the project and its progress . . . [the] Consent Decree . . . provides, among other things, for long-term maintenance and monitoring.*
Information noted	*The Tacoma kraft mill was acquired by Champion as a result of the merger of St. Regis Paper Company into Champion.*
Information noted	*The activities described in the subsection entitled "Sediment Remediation and Habitat Restoration" have been completed and approved by Ecology.*
Request noted	*The administrative record for this FS should include the Consent Decree [for the St. Paul Waterway area].*
Request noted	*Champion agrees with the comments of the Commencement Bay Group [and] urges EPA to seriously consider those comments in connection with the ROD.*

Citizen Letters (1989) (See Background on Community Involvement section)

City of Tacoma (1989)

See Response 3.3.1	*[T]hese efforts [to facilitate a cleanup plan] must be cost-effective and focused on achievable goals that accommodate the valuable commercial and industrial activity surrounding Commencement Bay.*
See Response 4.3.1 and 3.1.1	*The Apparent Effects Threshold (AET) does not provide an appropriate cleanup standard because it does not adequately differentiate between effects caused by individual chemical contaminants and effects caused by other factors. The proposed AET-based standard also targets some sediments for active remediation where there are thriving ecological communities.*
See Response 7.2.2	*We concur with the Feasibility Study that ongoing sources of contamination must be curtailed before any remedial dredging occurs, and support the concept of natural sediment recovery. However, we conclude that the criteria defining areas allowed to recover naturally are too restrictive . . .*
See Response 7.2.4	*An error was made in applying the sediment recovery model at the Head of City Waterway. A recalculation of the model using the correct data from the Feasibility Study indicated that most of the waterway will recover naturally if source controls are implemented. The dredge boundaries proposed in the Feasibility Study would result in needless costs and disruption of biological communities at both the dredge and disposal sites.*
See Response 8.2.1 through 8.2.8	*The Feasibility Study does not identify feasible and cost effective response actions for most waterways because it fails to identify available disposal sites for the quantities of materials proposed for dredging . . .*
See Response 8.4.1	*The Feasibility Study does not identify feasible and cost effective response actions for most waterways . . . because it greatly underestimates remediation costs. The cleanup plan proposed in the Feasibility STudy for $28 million could cost in excess of $100 million to implement.*
See Response 2.1.1	*Commencement Bay sediments do not pose a significant human health risk. The actual health risks from Commencement Bay sediments are similar to*

The actual health risks from Commencement Bay sediments are similar to those reported for Carr Inlet and other non-urbanized Puget Sound waterways, and are within the range of risks that EPA has considered acceptable in other situations.

See Response 6.5.1 — *The first element of the cleanup plan to proceed with is implementation of source controls. The City of Tacoma has already initiated a program to identify and remove existing sources of contamination from municipal storm drains, and we are also studying the feasibility of treating storm run-off entering the Head of City Waterway.*

See Response 4.4.2 — *In recognition of the AET and sediment recovery model limitations, we suggest that only sediments with concentrations clearly exhibiting benthic toxicity be remediated immediately, in order to take full advantage of natural recovery.*

See Response 3.2.1 and 3.2.2 — *Biological criteria used to define dredging boundaries must be based on analyses of the resident benthic communities. These analyses should be of sufficient detail to differentiate toxic effects from other site specific or environmental effects.*

See Response 9.5.4 — *In areas not clearly exhibiting benthic toxicity, sediment concentrations and biological recovery [should] be monitored at 5 and 10 years following completion of source controls. Sediments not meeting the long-term cleanup goal after 10 years [should not] be remediated.*

Request noted — *We suggest that the U.S. Environmental Protection Agency and the Washington Department of Ecology open a local office for their joint use. We further suggest that the local site managers be assigned full-time at that office.*

City of Tacoma (1989); Attachment A—Review of 10.0 Head of City Waterway

See Response 5.3.1 and 5.1.2 — *The Feasibility Study overestimates mass loadings for most sources . . . [and] has not adequately evaluated the nature and extent of [sources within drainage basins] based on our more extensive information.*

See Response 7.2.1 through 7.2.4 — *The SEDCAM model, as used in the Feasibility Study, overestimated the time required for natural recovery of City Waterway sediments. This overestimate of the time required for natural recovery is the result of erroneous assumptions.*

See Response 8.4.1 — *The estimated costs of sediment remediation are seriously underestimated by the Feasibility Study.*

See Response 6.2.1 — *The Feasibility Study proposes infeasible end-of-pipe source control measures.*

Request noted — *The "Environmental Significance" rating for the head of City Waterway should be "low" rather than "medium."*

(Plus additional comments following summary comments.)

City of Tacoma (1989); Attachment C—Review of Commencement Bay Integrated Action Plan

See Response 1.2.4 — *The Integrated Action Plan . . . suffers from the same reliance on AETs* *[as the Feasibility Study]; ignores dredging and disposal impacts; uses the SEDCAM model that underestimates the rate of natural recovery; does not consider the benefits to be derived from using a natural recovery goal greater than 10 years; proposes an inadequate biological testing program. These short comings . . . should be remedied before any actions are undertaken.*

(Plus additional comments following summary comments.)

Commencement Bay Group (1989) [also cited as ENSR (1989)]

See Response 5.1.2, 6.4.1 and 6.4.2 — *The RI did not identify and quantify contaminant sources in sufficient detail to allow reliable estimates of current contaminant loadings and achieveable source control. Because of inadequate source characterization, the source loading and source control estimates made in the FS are based on technically unsupportable assumptions. These estimates of two of the most fundamental elements of site clean-up, are highly uncertain and are likely to be in error [detailed discussion in Chapter 4 of the ENSR report].*

See Response 2.1.1 — *The FS over-estimated the human health risks in Commencement Bay by nearly an order of magnitude. This lower risk is within the generally acceptable range and is comparable to the risk reported in the FS for Carr Inlet the (the reference area) [sic]. This indicates that sediment clean-up based on human health risk is not warranted in Commencement Bay [detailed discussion in Chapter 3 of the ENSR report].*

See Response 3.3.1 — *The sediment clean-up objective, "no acute or chronic adverse effects on biological resources", using Apparent Effects Thresholds (AETs) as the clean-up standard, is not attainable sustainable [sic] in Commencement Bay. This goal defines pristine conditions. Commencement Bay is an active port and industrial area which cna [sic] never achieve pristine conditions. Prop wash, maintenance dredging and other urban activities will prevent the pristine goal from being achieved. There is insufficient source characterization information to predict attainment and maintenance of the AETs without repeated dredging and disposal. An achievable and sustainable sediment clean-up objective and standard should be established before implementing sediment remediation [detailed discussion in Chapter 1 of the ENSR report]*

See Response 4.1.1 — *AET's fail to establish cause and effect relationships between contaminants and biological responses.*

See Response 4.2.1 — *The long term sediment clean-up standard (AETs) can be a useful indicator of potential adverse effects, but is not an appropriate clean-up standard or proper measure of clean-up effectiveness [because of the following three comments on AET]. . . These flaws severely restrict the use of AET's as a clean-up standard. [detailed discussion in Chapter 2 of the ENSR report]*

See Response 4.3.1 — *[AET fail to] differentiate between adverse and non-adverse effects.*

See Response 4.3.2 — *[AET fail to] quantify the extent of adverse affects [sic].*

See Response 7.2.3 — *The sediment recovery model (SEDCAM) can be useful as an indicator of the relative rate of natural recovery but is not an appropriate tool for making major program decisions. Insufficient and unreliable model input data from Commencement Bay has resulted in recovery time predictions that may be several times longer than actual recovery times. Sediment recovery* *is best estimated by monitoring actual recovery following source control [detailed discussion in Chapter 5 of the ENSR report]*

See Response 8.2.1 through 8.2.8	*The FS failed to identify feasible and cost-effective response actions for most waterways. Most alternatives identified and evaluated in the FS including the preferred alternatives can not be implemented because of the lack of sufficient disposal capacity. [detailed discussion in Chapter 6 of the ENSR report]*
See Response 3.3.1 7.1.3 6.1.1 8.2.1 8.4.1 2.1.1 4.3.1 and 3.1.1	*Our basic concerns about the proposed cleanup plan include [are summarized as follows] . . . The cleanup goal for Commencement Bay should be realistically based on the present and future uses of the Bay. . . Natural remediation is an effective way to address this historical process, coupled with continuing efforts to "turn off the spigot" on ongoing pollution sources. . . Source controls should be implemented first, and their effectiveness measured, before any remedial dredging occurs. . . The Feasibility Study does not identify feasible and cost-effective response actions for most waterways because it fails to identify available disposal sites. . . and because it greatly underestimates remedial costs. . . Commencement Bay sediments do not pose a significant human health risk. . . AET . . . does not provide an appropriate cleanup standard . . . The AET approach also targets some sediments for active remediation where there may be thriving ecological communities. . .*
Deferred	*The no-effect station setting an AET may appear to satisfy the definition of AET simply because the sampling was truncated in the midst of a series of sporadic effect stations at a point where the highest concentration happened to be an adverse biological effect station. There should be some assessment as to whether the AET value is likely to be solely the result of sporadic effects rather than consistent adverse effects above the AET.*

(Plus additional comments in sections of the ENSR report.)

DNR (1989)

See Response 9.4.3	*[T]he FS [should] address: 1) How the decision to require (or not require a SIZ [sediment impact zone] will be made; 2) What technical bases are to be used to define the area of a SIZ; 3) What effect will a SIZ have on the long term timing of sediment remedial actions; 4) What monitoring of a SIZ will be required; 5) What long term remedial actions will be required where a SIZ is established; 6) What parties will be responsible for monitoring and, in essence, stand behind the SIZ.*
See Response 9.5.5	*Any CAD [site] would be an experiment and require more compliance and environmental monitoring than what has been identified in the FS cost analysis.*
See Response 8.2.5	*At the current time the Department of Natural Resources acting for the State of Washington in terms of aquatic land ownership does not approve of CAD sites because of the issue of monitoring and technical feasibility. . [and] liability. . . The feasibility of the CAD site is questionable.*
See Response 4.1.1	*The Department agrees with the basis premise that the AET method is the best method available at the present time to identify sediments requiring remedial action.*

See Response 1.2.1	*The Department agrees that the long term goal as translated into the AET values stated . . . in the Feasibility Study is appropriate and that the actual decision can be refined through additional biological analysis. . .The utilization of performance criteria is very appropriate. . .*
See Response 8.4.2	*The volume of sediment proposed for dredging has not been adequately determined even in a general way*
See Response 8.2.1	*The volume capacity of the nearshore fill and the CAD sites is probably significantly less than proposed.*

(Plus additional specific comments.)

DOT (1989)

Deferred	*Based on [information attached], WSDOT [requests to] be removed from [the CB/NT site] PRP list. . . [and requests a written response as to] why WSDOT was not sent even a general notice letter until April 24, 1989, well into the comment period on the RI/FS and at least five years into the RI/FS process.*

Dunlap Towing Company (1989)

See Response 5.2.4	*First it must be recognized that Commencement Bay is an urban estuary with a large drainage basin. Not only are there industrial pollutants entering the Bay, but contaminants from automobiles, farms and storm drains also run off into its waters.*
Deferred	*Some of [the fish in Commencement Bay] display abnormalities, the sources of which have not been identified for certain, however, they are the type of tumors and lesions that are generally found in fish from waters that have been contaminated with residues from non-point pollution sources such as automobile exhaust and pesticides as well as chemical manufacturing sources.*
See Response 3.3.1	*The goal of "no adverse affects" is inappropriate and would have a severe negative impact on one of the nations most active ports.*
See Response 8.4.1	*The costs of the remedial alternatives in the Feasibility Study are grossly understated and have been projected to be as much as three times these estimates.*
See Response 8.5.3	*The Feasibility Study does not adequately justify the costs of dredging compared to the minimal measurable environmental benefit it will provide.*
See Response 5.2.1 and 6.1.1	*The priority for cleanup of Commencement Bay should be the control of the sources of pollution (both point and non-point). . . Dredging should not be considered until source control and a monitored period of natural recovery have been completed.*

Foss Maritime Company (1989)

See Response 8.5.1	*Foss supports attempts to develop a cost-effective cleanup plan that is reasonable and appropriate under the circumstances present in Commencement Bay.*

See Response 3.3.1 — *[W]e question whether the long-term cleanup goal of no adverse effects on marine life is appropriate for an urban bay, a working port, and a developing economy.*

See Response 5.2.1 and 9.1.1 — *Control of airborne emissions and surface runoff from highways, storm drains, farms, construction activities, an other [non-point] sources simply may not be sufficient to support a goal of "no adverse effects."*

See Response 5.1.2 — *We believe [the FS] focus on ship building and repair activities as the source of copper and mercury in Middle Waterway is speculative. . .Other possible sources, such as nearby industries and storm drains in the Waterway, have not been considered thoroughly. . .[and] sampling conducted to date is not sufficient to provide a clear picture of contaminant distribution in the Waterway.*

See Response 4.1.1 — *[I]t does not follow that observed concentrations of [copper and mercury] should be the basis for cleanup decisions. The AET approach to sediment quality does not establish causality between a particular contaminant and a biological impact. . . Numerous studies, including ongoing work at the Asarco smelter in Tacoma, indicate that the metals in slag may not be generally bioavailable.*

See Response 8.4.2 — *The volume of contaminated sediments quoted in the FS (57,000 cubic yards) is likely underestimated [in Middle Waterway]. This volume assumes a 1.5 foot cut . . . more likely, however, a 2 to 3 foot cut would be used . . .*

See Response 8.2.3 — *Disposal of the [Middle Waterway] sediments in Slip 1 near the mouth of the Blair Waterway may not be feasible [because of an unsuited filing] schedule, . . . [difficulties in defining and apportioning] responsibilities for monitoring . . .the capacity of Slip 1 may be overstated in the FS . . [and] alternative sites for nearshore sills may be available close to Middle Waterway.*

See Response 8.4.1 — *Costs presented in Appendix D of the FS appear low by a factor of two or more. Specifically, the estimated costs listed for dike construction ($0.51/ cubic yard) should be more in the range of $8 to $12/cubic yard of dike, while the estimated costs for monitoring wells ($2,000/well) should be closer to $5,000/well. Despite the overall underestimate of cleanup costs, however, the relative cost ranking of cleanup alternatives is likely valid.*

Deferred — *Clamshell dredging and nearshore disposal appears to be a desirable alternative . . . [and] [a]ssuming cleanup of the Waterway is warranted, this recommendation appears appropriate for the reasons stated in the FS.*

General Metals (1989)

See Response 1.1.3 — *EPA's proposed remedy for the head of the Hylebos problem area is not appropriate or consistent with the National Contingency Plan.*

See Response 4.1.1 — *Remedial action consistent with CERCLA's "Protection of Human Health and the Environment" standards does not require dredging to meet AET levels. . . Dredging is not needed to meet ARARs. The AET level for PCBs is not needed to assure protection of human health. EPA is without the authority to compel the PRPs to dredge as part of remedial action in these circumstances.*

See Response 8.2.10 *We request that . . . EPA change its preferred alternative for the head of the Hylebos Waterway to source control with natural recovery or, in the alternative, if EPA re-analyzes its alternatives, to remove PCBs as an indicator chemical.*

See Response 5.1.1 *EPA's characterization of sources of PCBs is inadequate to support remedial action or to identify sources.*

See Response 8.5.1, 8.4.1 and 1.1.1 *EPA has not shown that the Agency's preferred alternative for the head of Hylebos Waterway is cost effective. . . First, the cost analysis is extremely inaccurate. Second, the plan is not reliable. Third, the plan does not adequately provide long term or permanent solutions to the contamination problems at the site.*

Griffin Galbraith Fuel (1989)

See Response 6.1.1 *Stopping all source and non source pollution should be our first priority.*

See Response 9.1.2 *After the sources of pollution are stopped we should give nature sufficient time to remediate the pollution. . . [T)wenty to twenty five years should be given for natural remediation.*

See Response 7.1.3 *Save dredging for those truly "Hot Spots," after source control, to disturb and spread the contaminated sediments as little as possible.*

See Response 8.5.3, 8.2.1 and 8.4.1 *A <u>current</u> cost-benefit analysis should be performed based on disposal sites and contracting costs available today. . . the sites used in the Tetra Tech study may not be practical solutions or will not be available.*

See Response 3.3.1 *One ex-director of the EPA stated that in some cases the agency clean up demands are for a more pristine state than occur in nature. We cannot overlook the fact that Commencement Bay is an industrial and population center. We need cleanup goals that are achievable with not eliminating people and their livelihood from the area.*

Deferred *Since it is estimated that I-5 contributes about 40% of the Commencement Bay pollution, the Department of Transportation and the State of Washington should be listed as Potentially Responsible Parties.*

Jones Chemicals, Inc. (1989)

See Response 3.3.1 *This site is a large working port, and has been an industrial area for 100 years. It is not realistic to believe that it can or should be restored to pristine conditions.*

See Response 1.3.1 and 1.1.2 *The goal of "<u>no</u> acute or chronic adverse effects" on marine organisms is not required by any applicable law and should not be adopted as the goal for cleanup. . . the plan as proposed could require continuous cleanup efforts to try to reach an unattainable goal.*

See Response 8.4.1 and 8.5.3 *. . . EPA's estimate [for costs at Superfund sites] is always below the actual cost, often by 100% or more. In addition, this cost does not include <u>any</u> of the costs of source control, which area a key part of the Integrated Action Plan. EPA is therefore contemplating a <u>societal</u> cost (regardless of who actually pays) of tens of millions of dollars. More consideration*

	should be given to whether the benefits to the environment and indirectly to human health justify that level of investment of society's resources.
See Response 8.2.1	*Perhaps the most important [specific problems with the plan] is the lack of any suitable disposal site for dredged material which is proposed for "nearshore disposal."*
See Response 9.1.2	*EPA should reconsider allowing more time for natural recovery, coupled with institutional controls, to work before any dredging occurs.*
See Response 8.5.2	*If dredging is necessary, the material should be disposed of using confined aquatic disposal for all areas within the site. According to EPA's figures, aquatic disposal is about 1/3 the cost of nearshore disposal and is much more likely to be feasible, given the lack of nearshore disposal sites.*
See above Responses	*In short, we support the following cleanup plan for the Nearshore/Tideflats site: aggressive source control to eliminate continuing sources of contamination, followed by a period of natural recovery. There is no reason why this period should be limited to 10 years if monitoring shows it is making satisfactory progress. Dredging should be a last resort if natural recovery is not making headway.*

Kaiser Aluminum and Chemical Corporation (1989)

See Response 6.1.1 9.1.1 6.3.1 and 9.2.1	*Effective control of all significant sources must occur before [undertaking] remedial action. . . the FS [has not] adequately identified potential sources, characterized sources [including non-industrial sources], or determined source loadings of contaminants to Commencement Bay. . . [and] timetables for remedial action do not give adequate allowance for the completion of source control. . .*
See Response 3.2.1 and 4.4.2	*[T]he goal for the cleanup [should] be defined based on what is necessary to protect human health and the environment from significant adverse impacts . . . cleanup should only be required in areas where an ecologically significant (not statistically significant) benefit can be shown.*
See Response 7.1.2	*[N]atural recovery [should] be the preferred cleanup alternative except in cases where it plainly will not protect human health and the environment in the long term. . . It does not disrupt the existing ecosystem or resuspend sediments. . . [and] is appropriate for an urban bay which has received contaminants for many years from many historic sources.*
See Response 8.3.1	*The negative impacts of dredging are not adequately considered in the Feasibility Study and supporting documents. . . [dredging] should not be used . . . where the impacts exceed the environmental benefits of remediation.*
See Response 9.1.2	*In the FS, the selection of ten years as an appropriate natural recovery period appears to be arbitrary. . . [the reasons cited do not] explain why a longer period is not preferable. . . the long-term goal of "no impact" was intended by the [Puget Sound] Plan to be much longer than a ten year period.*
See Response 8.4.1	*[T]he costs of the preferred remedial alternatives are greatly underestimated in the FS. In addition, the costs of source control . . . and monitoring costs were not included. . .*

See Response 8.2.1	*[T]he FS does not identify feasible disposal sites for dredged material.*
See Response 8.5.1	*It will be difficult for businesses located at the CBNT site to adequately budget and plan for the future if critical aspects of the cleanup plan may be changed mid-course.*
See Response 4.2.1 and 1.2.2	*AETs may be useful as predictive tools for the PSDDA program . . . [but not for] determining that a particular sediment should be remediated. . . Nevertheless, the FS still cites PSDDA as a justification for using AETs for cleanups. Given the different goals, the citation is inappropriate.*
See Response 8.4.2	*The FS admits that its area and volume estimates are based on multiple assumptions and are not likely to be accurate. . . FS decisions on remedial action alternatives are not appropriately based on such weak information.*
See Response 8.5.2 and 8.2.9	*The FS does not adequately justify nearshore disposal over confined aquatic disposal ("CAD") for the HHW [Head of Hylebos Waterway].*
See Response 9.2.2	*The comments of Kaiser and the CBG alone are far reaching (as necessitated by the complexity and size of the Site) and cannot truly be adequately addressed and responded to in just a few months [i.e., by summer or early fall of 1989].*
See Response 8.5.1	*. . . the agencies must not [in a performance based ROD] place the burden of meeting a certain cleanup standard on the PRPs unless at least one alternative is identified that both meets the standard and meets CERCLA's requirements regarding effectiveness, implementability, and cost.*
See Response 1.1.6	*Considering [urban runoff, historic sources, and NPDES-permitted discharges exempt from CERCLA coverage], the Superfund should be tapped to pay for a least a portion of the remediation costs at Commencement Bay.*
Comment noted	*Kaiser agrees that there are no feasible or cost effective treatment alternatives available for the large quantities of dilute contaminants present in Commencement Bay sediments.*
See Response 1.1.3	*A single Superfund action is not an appropriate way to address such a large and varied area. If anything, dozens of smaller sites should have been listed instead of one huge site.*
See Background Section	*In general, the study of the CBNT Site process was compromised by not soliciting input from industry -- the parties who should know the most about what is feasible at the Site. The agencies should now embark on a program to correct the misconceptions regarding Commencement Bay.*

Louisiana-Pacific Corporation (1989)

See Response 7.2.3	*The SEDCAM model needs to account for arsenic losses from sediments. . . Site-specific studies of arsenic fluxes from areas proposed for cleanup should be conducted . . . [and] used in evaluating whether natural sediment recovery is feasible for areas currently proposed for cleanup.*

See Response 5.1.2 and 6.1.1	*The FS does not accurately characterize arsenic sources and loadings into the head of the Hylebos. . . Sources contributing to Hylebos Creek must be curtailed before any cleanup of sediments . . . since Hylebos Creek is the largest contributor of arsenic in this immediate area.*
Deferred	*The priority rankings in the Integrated Action Plan do not reflect actual contributions of arsenic. . . Parties should not be given lower priority on the grounds that they are recalcitrant.*
See Response 6.4.1 and 6.4.2	*The evaluation of source control technologies in the FS does not provide sufficient consideration of factors encountered at log sort yards and wood waste landfills to hold that the technologies are feasible at log sort yards.*

Manke Lumber Company (1989)

See Response 9.2.1 5.2.1 and 5.1.2	*The implementation schedule suggested by the Feasibility Study (FS) creates a substantial likelihood of recontamination of remediated sediments [because] . . . many of the potential sources of contamination have not been identified . . . a number of [identified sources of contamination] have not yet been controlled . . . there is inadequate data with respect to many, if not most, point and non-point sources of contamination.*
See Response 7.1.2	*The natural recovery of the sediments should be the preferred remedial alternative, and should be abandoned only if absolutely necessary.*
See Response 8.3.1 and 1.1.7	*A dredge and fill operation would further destroy present biological communities . . . [and] would create secondary contamination problems at the site of disposal, contrary to the present Super Fund Policy to remediate contaminants on site.*
See Response 7.2.3	*The sedimentation rate estimated in the FS is based upon assumptions with out adequate data, and may well be understated.*
See Response 3.3.1	*. . . the goal of . . . "no adverse effects" . . . is not obtainable in an urban environment. . . Commencement Bay and its waterways cannot be returned to the pristine state they were in before man came to the Commencement Bay area.*
See Response 4.4.2	*A more realistic goal in an urban environment is no significant effect on biological resources.*
See Response 2.1.4	*The process by which health risks are estimated . . . is grossly exaggerated [sic]. The FS contains assumptions as to consumption of fish and fish livers which have no basis in fact.*
See Response 4.1.1	*[T]he AETs are faulty in as much as they do not establish a cause and effect relationship between contaminants and biological responses*
See Response 4.3.1	*[T]he AETs are faulty in as much as . . . they do not distinguish between adverse and nonadverse effects.*
See Response 4.3.2	*[T]he AETs are faulty in as much as . . . they do not quantify the extent of adverse effects.*
See Response 8.2.1	*The availability of disposal sites should be confirmed before the FS process is completed so that factor of cost effectiveness can adequately be addressed in the remedial action selection process.*

See Response 1.2.1 — *The cleanup goal has been created in a vacuum and is premature. The Department of Ecology is obligated in the future to develope [sic] Puget Sound-wide sediment standards for regulating discharges and for determining when sediment remedial actions are necessary. Those regulatory actions should occur prior to the finalization of the FS, and certainly before the issuance of any Record of Decision.*

Martinac Shipbuilding (1989)

See Response 2.1.1 — *While there does exist a problem to some degree, the implied threat to public health and the health of the marine environment has been grossly overstated.*

See Response 3.3.1 — *What is an appropriate and achievable level of cleanliness for an urban, industrial waterfront area? There is a balance that must be struck between the adverse effects to the marine environment and the adverse effects to the people who work at the businesses and live in the community.*

See Response 9.1.2 — *[W]e should seriously consider extending the time horizon allowed for natural recovery to occur. We are dealing with a 100 year old problem and in relative terms proposing to solve it overnight.*

National Oceanic and Atmospheric Administration (1989)

See Response 1.3.4 — *The long-term goal of "no acute or chronic effects on biological resources" would be protective of NOAA trustee resources. [Because] cost and technical feasibility are factors that would be considered in the overall evaluation of actions . . . [the goal] may not be achieved in all areas under the Superfund cleanup.*

See Response 3.3.2 — *The use of lowest AET values is probably the most appropriate general approach to setting target levels in Commencement Bay, even though the approach has not been fully developed. . . It is clear that AETs do represent concentrations that are associated with biological impacts. Thus it can be concluded that the AETs are clearly based on documented effects, but may easily underestimate the full range of injury that may be caused by toxic substances [e.g., chronic effects].*

See Response 4.3.2 — *The possibility exists that combinations of two or more substances may result in greater toxicity than indicated by the individual AET values. In the case of Commencement BAy, however, the AETs are based on local data so that the last concern should not be a problem. In addition, the test procedures upon which the AET are based are probably the most reliable and may be among the most sensitive available. . . Finally, the AET approach provides a means of evaluating the need for remediation of sediments from deeper cores that may not be completely testable [using biological indicators].*

See Response 9.1.2 — *The proposed 10-year "natural recover" period proposed in the FS presents some substantial problems . . . [because] Superfund legislation has only been authorized in increments of five years or less, with the strong implication that cleanup should be completed at many sites within that time frame . . . No justification is presented, nor is any analysis given, for the statement that a 10-year period presents an "optimal balance" between cleanup-associated disruption and the problems associated with the toxic*

	substances [which by allowing] to continue will also continue to injure natural resources and threaten human health.
See Response 7.2.1 and 7.2.3	*[T]he change in concentrations in the surface sediments in most areas will be on the order of a factor of two after 10 years of "recovery." This level of change is on the order of the precision with which the concentrations of substances in the sediments can be reliably measured, and within the accuracy of the [SEDCAM] model. AS a result, the potential for error in meeting the cleanup goals if the recovery period calculation is allowed is large.*
See Response 9.2.3	*[I]t may be difficult to determine after 10 years that recovery has actually taken place. If not, will the PRP be allowed another 10 years to demonstrate that the process is working? [This] could lead to substantial failures to meet the cleanup goals.*
See Response 9.1.2	*While the PSWQA does include the recommendation that natural recovery be considered in cleanup action, it does not specify that 10 years should be used and the consideration does not necessarily apply to Superfund sites. In addition, the contamination at this site was identified and has been studies, with limited real action, for 10 years already.*
See Response 7.1.1	*Since [the natural recovery] process is limited to only the upper layer of contaminated sediments (upper 10 cm), any contamination in the deeper sediments will be unaffected. This process is therefore defacto in situ capping. In situ capping was rejected for all waterways except the St. Paul because of the high likelihood that the sediments in all of the other waterway would be dredged for maintenance or new construction.*
See Response 7.1.3	*The proposed "natural recovery" is simply a slow form of dilution. The same result could be achieved without the delay and uncertainty that would occur by allowing in situ capping. The recovery period sets a precedent of allowing dilution as part of a Superfund cleanup action. This approach has been clearly rejected at all other sites.*
See Response 1.1.1	*The FS is clear in recognizing that none of the confinement options meet the SARA preference for a permanent solution, as defined by reductions in the toxicity, mobility, or volume of the contamination.*
See Response 8.4.1	*[M]onitoring and maintaninance [sic] [of nearshore disposal sites] will have to perpetuated [sic] for centuries to come. It is questionable whether the costs of this long-term O&M have been fairly incorporated into the feasibility study, since it appears that only a 30-year period was used and for some sites, monitoring is costed for the first 10 years.*
Deferred	*In general, the [sampling and monitoring] guidelines are reasonably well thought out, but could be more specific with regard to the numbers of stations that may be needed.*
Deferred	*The bioassay recommendations are reasonable, but may well need to be revisited in the not-too-distant future as new bioassays are developed. . .*
Deferred	*The statement in the appendix [p. A-10 of the Integrated Action Plan] that the exceedance of a single chemical cleanup goal [in a marginally contaminated area] may be negotiable does not seem to be supported in the main body of the text. Since six of the nine problem areas have only two or [one] problem substances, this provision would seriously weaken the*

potential cleanup and may lengthen the negotiation period. It should not be accepted.

See Response 9.2.3	*[W]hen the proposed 10-year clock for natural remediation starts is not clearly stated. . . It is essential that the sequence of all events be clearly established.*

Occidental Chemical Corporation (1989)

Deferred	*The [RI/FS] reports do not consistently and clearly distinguish that [Occidental Chemical Corporation] is not the identified source of the high priority contaminant PCBs in the mouth of the Hylebos Waterway. . . [a]s a result [of the detailed Remedial Investigation at the OCC Tacoma Plant site] OCC concludes they are not the source for PCBs to the Mouth of the Hylebos.*

Pennwalt Corporation (1989)

See Response 1.1.2	*[The] "no effects" standard is not realistic or achievable as a cleanup standard for an urban waterway like Commencement Bay. Nor is it legally required as a cleanup standard under section 121(d) of SARA, 42 U.S.C. ss 9621(d), the current or proposed National Contingency Plan (NCP), or EPA guidance documents.*
See Response 4.4.2	*[An] alternative cleanup goal [is proposed]: mitigate significant effects to the aquatic ecology. . . Under this objective, only those sediments with significant benthic depressions and which offer significant and measurable ecological benefits would be identified as suitable candidates for active remediation.*
See Response 8.2.10	*The FS does not identify a feasible or cost-effective remedial alternative for the head of Hylebos Waterway. A modified institutional controls alternative should be the preferred alternative for the head of Hylebos Waterway . . . [requiring] removal only of the sediments that would exceed cleanup standards after source controls, natural remediation, and maintenance dredging.*
See Response 8.5.2	*Confined aquatic disposal may be preferable to nearshore disposal for any sediments that require dredging.*
Comment noted	*The FS correctly rejected treatment alternatives*
See Response 8.5.1	*A performance based record of decision is only appropriate if the performance standard is based on a feasible and cost-effective alternative. . . It is impossible to determine whether the cleanup standards and performance criteria are feasible and cost-effective, as CERCLA requires, unless they are tied to a particular remedy.*

(Plus additional comments in an attached report by Kennedy/Jenks/Chilton (1989) following these summary comments.)

Pickering Industries Inc. (1989)

See Response 5.1.3 and 7.1.3	*We do not agree that [City] waterway needs to be dredged. . . We believe EPA should first control the sources of contamination, and then should leave the City waterway alone for an extended period of time, for example, 10 years or more, to see whether the pollution has abated naturally. . . [i]f it has not, a decision can then be made about dredging.*
See Response 3.3.1	*We are very concerned that the standards the feasibility study uses are too high for the [City] waterway.*
See Response 2.1.1	*[Apparently] the feasibility study attempts to clean the City waterway so that English sole do not develop cancerous tumors. . . a person would have to eat absurdly large quantities of fish liver for their entire lives in order to contract cancer from such fish. . . this is totally unrealistic and presents and inappropriate standard by which to determine whether dredging is necessary.*

Port of Tacoma (1989)

See Response 5.1.2	*A particular concern is the inadequacy of the data base for historic and current sources.*
See Response 6.4.1	*[T]he FS overestimates the feasibility and effectiveness of source control measures.*
See Response 6.4.2	*The FS establishes a goal of 60-95% control of all sources. It is not clear whether the 60-95% requirement will be additional to source control measures implemented since RI sampling in 1985 . . . [or] how the goal will be verified due to the lack of baseline data.*
See Response 8.4.1	*The considerable costs of source control, monitoring, and future implementation are not included in the FS. . . The cost estimate of $28 million significantly underestimates the cost of implementing the preferred remedial action [which is estimated to be] three to four times greater than stated in the FS.*
See Response 3.3.1	*[T]he FS' proposed cleanup goal for this Superfund site, unlike cleanup levels in other urban marine sites, requires the equivalent of pristine conditions. . . [the] proposed cleanup standards . . . are not attainable nor sustainable within Commencement Bay's urban setting.*
See Response 5.2.1	*The FS performance standard does not acknowledge the impact of recontamination from continuing sources [including urban runoff].*
See Response 9.4.3	*The relationship between [Ecology's] implementation of sediment impact zones and cleanup standards needs to be addressed.*
See Response 7.2.3	*Use of the SEDCAM model (which has not been field tested) to predict future sediment conditions may have led to incorrect conclusions concerning the proposed remedial actions.*

See Response 4.1.1 and 4.2.1	*. . . the AET method is appropriate only as a screening tool to identify areas warranting more thorough environmental investigation . . . [because] AETs cannot demonstrate specific cause and effect relationships. AETs also cannot predict that an environmental effect will be caused by levels of chemicals that exceed the AET level.*
See Response 4.3.2 and 4.3.1	*The AET artificially ascribes all changes in benthic communities as being equally adverse, and assumes all changes are due to the presence of chemical contaminants.*
See Response 4.2.2	*Use of AET is particularly questionable in intertidal areas.*
See Response 4.4.2 and 4.3.1	*Given the probable need to proceed with some cleanup, and in the absence of consensus on sediment quality measurements, the Port supports application of the AET approach defined in the CBG/ENSR report, provided that proper consideration of physical factors is given during cleanup decisions.*
See Response 2.1.1	*The FS overestimates the relative human health risks of sediment contamination in Commencement Bay. . . by using unrealistic assumptions.*
See Response 9.3.3	*Plans for remedial dredging should recognize plans for navigation dredging. When navigation needs are considered, the total volume of sediments requiring confined disposal will be much larger than that predicted solely for remedial dredging.*
See Response 8.2.9	*Feasible and cost-effective strategies for removing contamination under [pier] structures are not identified nor discussed [although] capping or removal of surface sediments involves a high risk of pier structure or slope failure . . . methods are infeasible . . . untried and costs range from $1.7 to $5.5 million.*
See Response 8.2.1	*The FS does not identify cost-effective and feasible disposal sites for the large quantities of sediments designated for cleanup.*
See Response 8.2.3	*The present timetable for cleanup will result in [proposed disposal site in Blair Waterway] Slip 1 not being available. . . other Port owned disposal sites are also not available.*
Deferred	*[T]he agencies [should] consider further the following three [disposal] sites: 1) the Wheeler Osgood Waterway; 2) the Saint Paul Waterway; and 3) the Hylebos Disposal Site #1 (combined use with fisheries enhancement).*
See Response 1.2.4	*In particular, the Port is concerned about the regulatory status of the Integrated Action Plan. . . What is the process for public comment on the IAP?*
See Response 6.1.1	*A systematic look at all sources, their contribution, degree of achievable control, and priorities for control should be defined. The framework for such a plan should be established prior to the ROD. . .*
See Response 5.2.2	*Resolution of source control and drainage planning issues related to the uplands must occur prior to issuance of a ROD for submerged portions of the site. . . Without a RI/FS and a ROD for source control, PRPs cannot obtain CERCLA resolution of Superfund liability.*

(Expansion of comments followed in attachments "Analysis of Proposed Surface Water Source Control Requirements for the Commencement Bay Nearshore/Tideflats Superfund Area" by R.R.

Horner; Hart Crowser review letter; "Contaminated Sediments on Side Slopes of Sitcum Waterway" by Berger/ABAM Engineers; "Review of Various Aspects of Commencement Bay Nearshore/ Tideflats Feasibility Study" by Berger/ABAM Engineers; and "Assessment of Risks Associated with Eating Recreationally Harvested Puget Sound Seafood" by L. Williams and C. Krueger; and public testimony at 6 June 1989 meeting by J. Terpstra.)

Premier Industries Inc. (1989)

See Response 6.1.1 and 7.1.2	*[S]ource control [including non-industrial sources] and natural remediation appear to be the most economical and effective means for cleaning up Commencement Bay.*
See Response 9.2.4	*Further testing and evaluation is mandated to identify and quantify "Toxic Hot Spots" . . .*
Deferred	*As an alternative to removing approximately 11,000 cubic yards of contaminated soil and finding a disposal site [for Wheeler-Osgood sediment], why not construct a sea wall and fill in the waterway with approximately 75,000 cubic yards of dredged material from the City Waterway and cap with clean soil.*

PSWQA (1989)

See Response 1.3.1	*The long-term sediment cleanup goal selected for Commencement Bay is also the sediment goal of the Puget Sound Water Quality Management Plan . . . The Authority supports adoption of this goal.*
See Response 1.2.1	*The Authority supports the use of the apparent effects threshold method (AET) to estimate chemical concentrations associated with harm to marine life. The use of bioassays to refine areas and volumes for remediation is also supported.*
See Response 7.1.2	*The Authority . . . supports the use of natural recovery, after source control has been achieved, for portions of the sites that will recover within ten years. The dilution and burial of moderately contaminated sediments by clean sediment is an acceptable way to accomplish the cleanup goal.*
See Response 7.2.3	*Authority staff have questioned . . . [whether] the rates of recovery predicted by the [SEDCAM] model are too slow and underestimate the rate of natural recovery.*
See Response 6.1.1	*The application of all known, available, and reasonable methods of treatment to all point sources and rigorous application of best management practices to nonpoint sources is required.*
Suggestion noted	*Improved spill prevention programs throughout the drainage basin and improved spill response capabilities should be addressed [in the IAP].*
See Response 9.4.3	*If the continued discharge [that still results in sediment contamination] is clearly in the public interest, a wastewater discharge permit should define a specific sediment dilution zone (also called a sediment impact zone) for the discharge, and require periodic maintenance. . .until better methods of treatment can be identified and implemented. [This permit] should not delay capping or dredging contaminated sediments . . . such cleanup actions provide a clean baseline for monitoring the discharge.*

See Response 8.3.2	*The Authority supports the use of a range of remediation techniques, depending on site conditions. . . [but] The policy of no net loss of wetland habitat, as adopted by EPA, the State of Washington, and the Puget Sound Plan, must be met.*
See Response 9.5.4	*Monitoring [of cleanup and disposal sites] must be required.*
See Response 3.3.1	*The Authority supports cleanup of Commencement BAy because of the public benefits that will result. . . [from mitigation of harm to] natural marine life . . . [and reduction of] human health risk associated with eating seafood.*

Puget Sound Plywood, Inc. (1989)

See Response 3.3.1	*Our first concern is that the Feasibility Study's cleanup goals are unrealistic because they fail to adequately account for the present and future uses of Commencement Bay.*
See Response 6.6.1	*[T]he Feasibility Study does not place sufficient emphasis upon stopping ongoing pollution at its source and allowing natural recovery processes to remediate much of the existing sediment pollution problem.*
See Response 6.6.1 and 7.1.2	*[S]ource control should be fully implemented and tested before sediment remedial dredging occurs.*
See Response 8.2.1	*[T]he Feasibility Study fails to identify feasible and cost-effective response actions because, among other matters, it does not clearly and convincingly identify disposal sites for contaminated sediments.*

Puyallup Tribe of Indians (1989)

See Response 1.1.4	*[T]he Tribe has not been provided with a meaningful opportunity to participate in [the FS] proceeding.*
See Response 1.1.3	*The FS should take into consideration EPA's proposed NCP which implements SARA.*
See Response 1.1.1	*The goals of the FS must be permanent cleanup.*
Request noted	*The Tribe formally requests documentation demonstrating that [EPA's and Ecology's contractors] have no conflict of interest with any Potentially Responsible Party [at the CB/NT site].*
See Response 1.3.5	*Tribal standards must be considered as ARARs*
See Response 1.3.7	*The Puyallup Land Claims Settlement Agreement . . . must be considered as an ARAR.*
See Response 1.3.2	*EPA's proposed Maximum Contamination Level Goals must be adopted as a groundwater ARAR [not as a TBC]. . . The American Indian Religious Freedom Act, the National Historic Preservation Act and Tribal standards must be considered for all locations impacting Tribal resources.*
See Response 3.3.1	*. . . Commencement Bay [must] be fully remediated, and protected as an exercise of . . . public trust.*

See Response 7.1.1	*[T]he identification of contaminated sediments [may be] greatly underestimated. . . capping dangerous sediments in place . . . will not provide adequate human and environmental protection.*
See Response 7.2.3	*The use of the SEDCAM model is likely to underestimate recovery rates.*
See Response 8.4.1	*The use of a 10 percent discount rate over a 30 year period does not accurately reflect the long term costs of monitoring and maintaining a site through institutional controls.*
See Response 1.3.4	*[A]ll of [the nine criteria used to evaluate the alternatives] are not entitled to equal weight. Protection of human health and the environment must be the most important criteria.*
See Response 1.1.1 and 1.3.5	*The Puyallup Tribe finds the recommended remedial action alternative totally unacceptable . . . [because it] will not prevent bioaccumulation . . meet tribal standards. . . [and] is not a permanent solution.*
See Response 2.1.4 and 2.1.6	*The FS must address cumulative health impacts to Tribal families that rely on fish for a large portion of their diets, and to fishermen that spend a lot of time fishing within Commencement Bay . . . [including] effects of dioxins, heavy metals, and thousands of other chemicals [besides PCB mixtures] . . . Cumulative health risks from all dangerous chemicals must be addressed.*
See Response 6.1.1	*A source control strategy must develop specific plans for [immediate] control of permitted, unpermitted point source, and nonpoint source discharges. . . before significant sediment remediation is undertaken.*

(Plus numerous additional specific comments and attached Superfund Memorandum of Agreement, Puyallup Tribal Water Quality Program, Letter documenting Tribal ARAR, resolution requesting inclusion of Tribal Environmental Standards, and U.S. EPA Drinking Water Regulations and Health Advisories.)

Sierra Club (1989)

See Response 3.3.1 and 6.1.1	*While we recognize that industry has been located in this area for a good many years, we must not zone the bay into clean and dirty areas, but rather assure multiple uses of the bay. . . Appropriate technologies must be utilized to prevent continued contamination of these waters and adjoining sediments.*
See Response 1.1.2	*The Sierra Club supports the long-term cleanup goal [of no adverse effects]. . . Of the several potential approaches for establishing sediment quality values, the AET approach seems the best in measuring acute harm. . . SPecific cleanup plans must go beyond the current AET assessment to include a complete assessment of chronic (sublethal) impacts and should address these impacts in the Record of Decision.*
See Response 3.3.2	*If further refinement does not allow complete assessment of AETs for chronic effects, we recommend that some chemical concentration ten to one hundred times* ***below*** *the lowest AET should be selected as the threshold for cleanup and monitoring, to provide a margin of safety and to allow for the unmeasured chronic effects mentioned above.*

See Response 1.1.1	*[A]ll cleanup efforts should meet the requirements of SARA and must be permanent. . . Because [permanence is not assured until specific disposal sites can be evaluated] we cannot support the preferred alternative.*
See Response 9.1.2	*If recovery cannot be demonstrated at [natural recovery sites] in the next five years, this approach should be reevaluated.*
See Response 6.1.1 and 9.5.4	*[A] <u>strong</u> source control program [is supported] . . . sediments . . . should be monitored for potential re-contamination.*

Simpson Tacoma Kraft Company (1989)

Comment noted	*Simpson agrees with the preferred alternative and generally agrees with the conclusions in the FS.*
Information noted	*[There is incorrect] [a]ttribution of historical problems to Simpson, which acquired the mill . . in 1985 [rather than to the Tacoma Kraft Mill and raw materials].*
Information noted	*[O]utdated information [is used in some cases] regarding source control and remedial action at the site [in the St. Paul Waterway area].*
Information noted	*[S]ome inaccurate and inconsistent conclusions [are made] on the summary charts [for the waterway].*
See Response 8.2.7	*[The FS incorrectly] suggest[s] that a new technology might be implemented rather than the preferred remedy evaluated and identified in the FS.*

Superior Oil Company (1989)

See Response 7.1.3	*Superior Oil agrees that [the "wait and evaluate" approach for the mouth of City Waterway] is reasonable, cost effective and protective of human health and the environment.*
See Response 3.3.1	*The [long-term] cleanup standard of "no adverse effects" does not recognize . . . [the fact that] City Waterway is unquestionably located in the heart of an industrial area. . . it is probably an unattainable standard.*
Information noted	*[T]here is nothing in the RI or FS that establishes a link between Superior Oil property and the contamination found in the City Waterway [despite one contradictory section in the FS that should be corrected].*

Tacoma-Pierce County Chamber of Commerce (1989)

See Response 6.1.1 and 6.3.1	*Ecology's and EPA's first objective should be to control existing sources of pollution to Commencement Bay before requiring that industry, the City, the Port and landowners invest an estimated $28 million on sediment remedial action.*
See Response 8.5.3	*No remedial action should be allowed, using private or public funds, until the benefits of action are presented for public review and the benefits clearly exceed the costs.*

See Response 1.1.6	*If . . .sediment remedial action should proceed after the public comment period closes, then the only reasonable approach would be to provide for a substantial CERCLA-funded percentage of the cost of remedial action.*
See Response 3.3.1	*The government should not aim to return the Bay to "natural" conditions . . . EPA's announced goal of "no adverse impact" is too stringent and fails to appreciate the reality of our urban setting.*
See Response 8.4.1	*EPA's figure of $28 million to cleanup the Bay is an underestimate [because of higher costs for alternative disposal sites, and sampling and analysis].*

Tacoma-Pierce County Health Department (1989)

See Response 6.1.1 and 6.3.1	*[A] greater emphasis needs to be placed on source control in the "integrated Action Plan" and a fully funded, pro-active, resource intense, source control program be developed and implemented. . . We would only be supportive of sediment removal or capping following a re-evaluation of the success of the above-described source control program.*

Tacoma-Pierce County Superfund Citizens Advisory Committee (1989)

See Response: Future Community Relations Plans section	*It is unclear how the agencies plan to promote public involvement in the cleanup process, but it is critical that the general public have access to specific and accurate information and are able to help shape decisions. . We hope documents are made available to members of the general public at little or no cost, and that it is easy for the public to obtain them.*
See Response 1.1.1 and 6.1.1	*The CAC supports the long-term cleanup goal . . .The CAC also feels that all cleanup efforts should be permanent, and that long term monitoring is essential. In addition, the CAC supports implementation of a strong source control program.*
See Response 1.2.3	*[T]he Department of Ecology and the EPA should continue to monitor activities in [areas other than the nine high priority problem areas], and should require site characterization and remediation prior to development.*

U.S. Army COE (1989)

See Response 1.2.2	*Some references [to the PSDDA study documents] are not totally correct and events subsequent to the preparation of the text have resulted in changes to the PSDDA management plan, portions of which are referenced in the FS text*
Deferred	*Proposed modifications of the PSDDA procedures [for analysis of dredging cut samples] in high priority areas . . . do not appear to be technically defensible and could result in unnecessary costs.*
See Response 3.2.4	*In the interest of consistency among the various sediment programs, consideration should be given to adopting the current PSDDA test protocols and guidelines for establishing what constitutes a bioassay "hit".*
See Response 8.2.5 and 9.5.1	*Siting of a deepwater CAD facility . . . should be undertaken . . . with consideration given to the PSDDA disposal siting process and the wide range of siting factors which must be taken into account.*

USG Interiors, Inc. (1989)

See Response 3.3.1	*Achieving [a "no adverse impact"] cleanup standard is neither appropriate nor achievable in Commencement Bay. . . The environmental concerns of Ecology and USEPA must be balanced with economic considerations.*
See Response 8.5.1	*With respect to the use of a performance-based Record of Decision . . . CERCLA requires that a remedy be chosen prior to the beginning of remedial activities. Ecology and USEPA, therefore, may not implement or require the implementation of remedial measures not specifically embodied in its ROD.*
See Response 6.1.1 and 6.3.1	*All [point and nonpoint] source discharges must be controlled prior to the implementation of containment measures.*
Deferred	*Source control coupled with natural recovery assisted by high tides and the removal of up to two-thirds of contaminated sediment through maintenance dredging may be sufficient to eliminate contaminated sediment and obviate the need for further remedial dredging.*
See Response 8.2.10	*[T]he dredging and disposal options proposed for the Head of Hylebos Waterway problem area both threaten to increase rather than reduce the negative impacts of existing contaminated sediment and are technically infeasible. . . Watertight clamshell dredges as well as other Japanese dredging technologies (mechanical, hydraulic, pneumatic) should be investigated to reduce the potential resuspension of sediment.*
See Response 8.2.1	*[N]o practical [nearshore] disposal site has yet been identified.*
See Response 8.4.1	*Given the scope and complexity of the proposed cleanup, [the $28 million] costs appear to be grossly understated.*

Washington Public Ports Association (1989)

See Response 9.3.1	*It is very important that [maintenance] dredged material . . . which passes the Puget Sound Dredged Disposal Analysis (PSDDA) requirements be allowed to go to the PSDDA disposal sites.*
See Response 3.3.1	*WPPA questions the goal of "no adverse effects due to sediment contamination" as a cleanup goal*
See Response 6.2.1	*The study should contain a more detailed cost evaluation for individual source control measures.*
See Response 7.2.3	*[I]t may be desirable to further test the predictive ability of the SEDCAM model before committing to remedial actions in ten years . . .*
See Response 4.1.1	*[T]he ports support [the use of AET] as a screening tools (as was done in the PSDDA study). However, we are concerned with the use of AET's as a cleanup standard. . .AET's cannot be used to predict cause and effect*
See Response 4.3.2	*. . . AET do [not] clearly indicate the ecological relevance of levels of contamination that exceed AET levels.*
See Response 8.2.1	*[W]e are very concerned about the lack of disposal sites for the volume of sediments that may be dredged . . . establishing a superfund disposal site within an urban area will be a very difficult task . . .*

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ATTACHMENT TO APPENDIX B

Community Relations Activities

Community relations activities have been conducted by Ecology and EPA with assistance from TPCHD. This list refers specifically to Nearshore/Tideflats and *Areawide* activities. It does not include activities specific to ASARCO, Tar Pits, and South Tacoma Channel sites. Community relations activities include the following:

- Prepared the initial community relations plan (1983)
- Established and provided staff support for Citizens Advisory Committee [started in September 1983 with regular meetings ongoing through spring (1989)]
- Established and maintained information repositories (1983-present)
- Developed and maintained mailing list of interested individuals (1983-present)
- Periodically briefed Tacoma-Pierce County Board of Health and city/county government officials
- Provided information for working sessions with Pierce County Medical Society (1983)
- Gave presentations to elementary and high school students, to workshops for teachers (winter 1986), and to schools and community groups (1983-1986)
- Held press conference and gave tours of Commencement Bay (June 1984)
- Gave tours of Commencement Bay to the Citizens Advisory Committee (1984, August 1988) and student groups (June 1986)
- Distributed periodic Commencement Bay Superfund updates to the community (September 1986, April 1987, August 1987, March 1988, May 1988, April 1989, September 1989)
- Gave 27 community interviews for revised community relations plan (September 1987)
- Published notice and analysis of proposed plan in Tacoma News Tribune (24 February 1989)
- Distributed proposed plan fact sheet to over 2,500 individuals (24 February 1989)
- Presented public workshops, meetings, and hearings:

NOAA report, TPCHD fish advisory	April 1981
Cleanup plans	June 1983
Progress report	March 1984
Remedial investigation study plan	November 1984
Commencement Bay dredging disposal	September 1985
Remedial investigation results	June 1985
Remedial investigation results and comments	July 1985
Status report	November 1985
Tideflats businesses (business liability)	April 1989
Proposed plan	21 March 1989
Proposed plan and public comments	6 June 1989

- Provided briefing for public officials and members of the press (February 1989).

APPENDIX C

Implementation Schedules for Source Control and Sediment Remedial Action

CONTENTS

LIST OF FIGURES

IMPLEMENTATION SCHEDULES FOR SOURCE CONTROL AND SEDIMENT REMEDIAL ACTION

In this appendix, recent, ongoing, and planned activities are summarized for the major problem areas of the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund site. Timelines depict major actions pertaining to the characterization and remediation of sources and adjacent sediments from 1987 to 1995. Details of source-related actions are provided in the supporting text.

The information contained in this section, particularly regarding the nature and timing of future actions, is tentative and was developed for planning purposes. The timing of source control actions is highly dependent upon the availability of agency staff and financial resources, the success of negotiations with potentially responsible parties (PRPs), and source control and investigation results.

Identification of additional sources will be supported by Urban Bay Action Team (UBAT) activities. The 1989 Puget Sound Water Quality Authority plan (PSWQA 1988) requires that action teams carry out various source control and investigative actions, including searches for unpermitted discharges, investigations of storm drain and groundwater contamination, and regulatory enforcement. The timing of sediment remedial actions is dependent upon the priority ranking of the problem area, the successful implementation of source control actions, negotiations with PRPs, the successful completion of the remedial design phase, and necessary coordination of remedial action with activities conducted in other problem areas. Because of these complicating factors, the timing of sediment remedial activities is subject to the greatest uncertainties. The schedules for source control and remedial activities reflect the status of those activities as of July 1989.

Remedial activities associated with storm drains in each of the problem areas will be regulated by the new National Pollutant Discharge Elimination System (NPDES) permit regulations to be adopted early in 1990. NPDES permit applications for industrial storm drains will be due 1 year later. NPDES permit applications for municipal storm drains will be due 4 February 1992. In addition, the 1989 PSWQA plan (PSWQA 1988) requires that local governments begin developing stormwater programs by 31 December 1989 and demonstrate significant progress on the programs by 31 December 1991. By the year 2000 the stormwater programs must be implemented.

HEAD OF HYLEBOS WATERWAY

Remedial activities at the Head of Hylebos Waterway are summarized in Figure C-1. Numerous sources have been associated with sediment contamination at the head of the waterway, including Pennwalt Chemical Corporation; Kaiser Aluminum and Chemical Corporation; General Metals, Inc.; several log sorting yards; and the landfills in the Hylebos Creek drainage basin. The locations of existing industries in Hylebos Waterway are shown in Figure C-2.

In the last several years, Kaiser Aluminum has implemented several remedial actions. These actions include re-routing of in-plant wastewater streams, installation of a settling basin between an NPDES-permitted discharge and Kaiser Ditch, and installation of a tide gate in Kaiser Ditch. Remaining scrubber sludges on the western portion of the site are addressed in the Sludge Management Closure Plan, submitted to the Washington Department of Ecology (Ecology) in September 1987, which proposed in-place capping as the preferred remedial action. Ecology has required additional groundwater monitoring and soil testing, as well as a risk assessment to determine whether the remaining scrubber brushes will need to be removed or if they can be disposed of onsite. A consent decree is in the draft/negotiation stage and should be completed in January 1990. It is anticipated that site stabilization activities will be performed during the summer of 1990 and require less than 6 months to complete. The effluent from Kaiser Aluminum is monitored under an NPDES permit, which is due for renewal in November 1989.

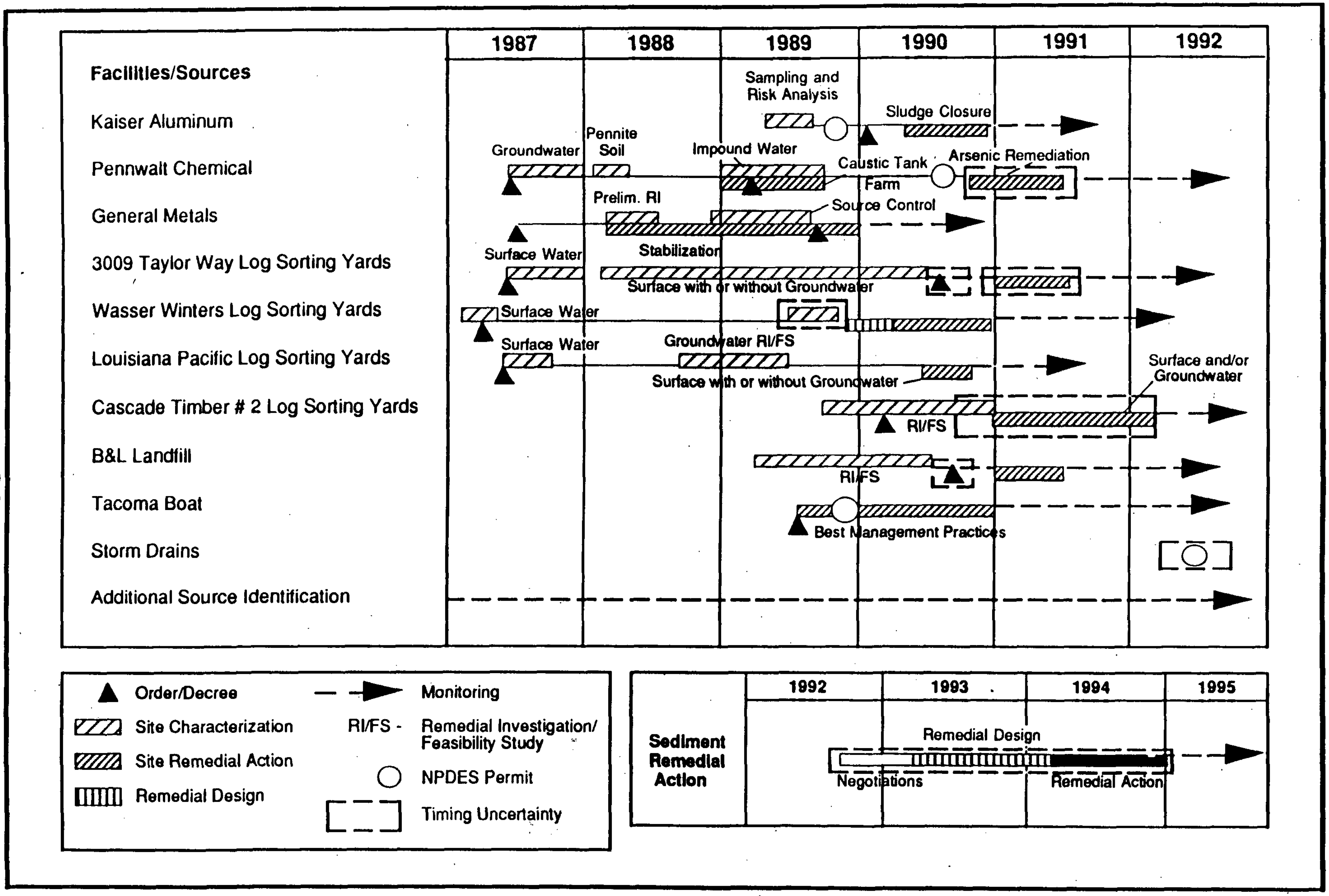
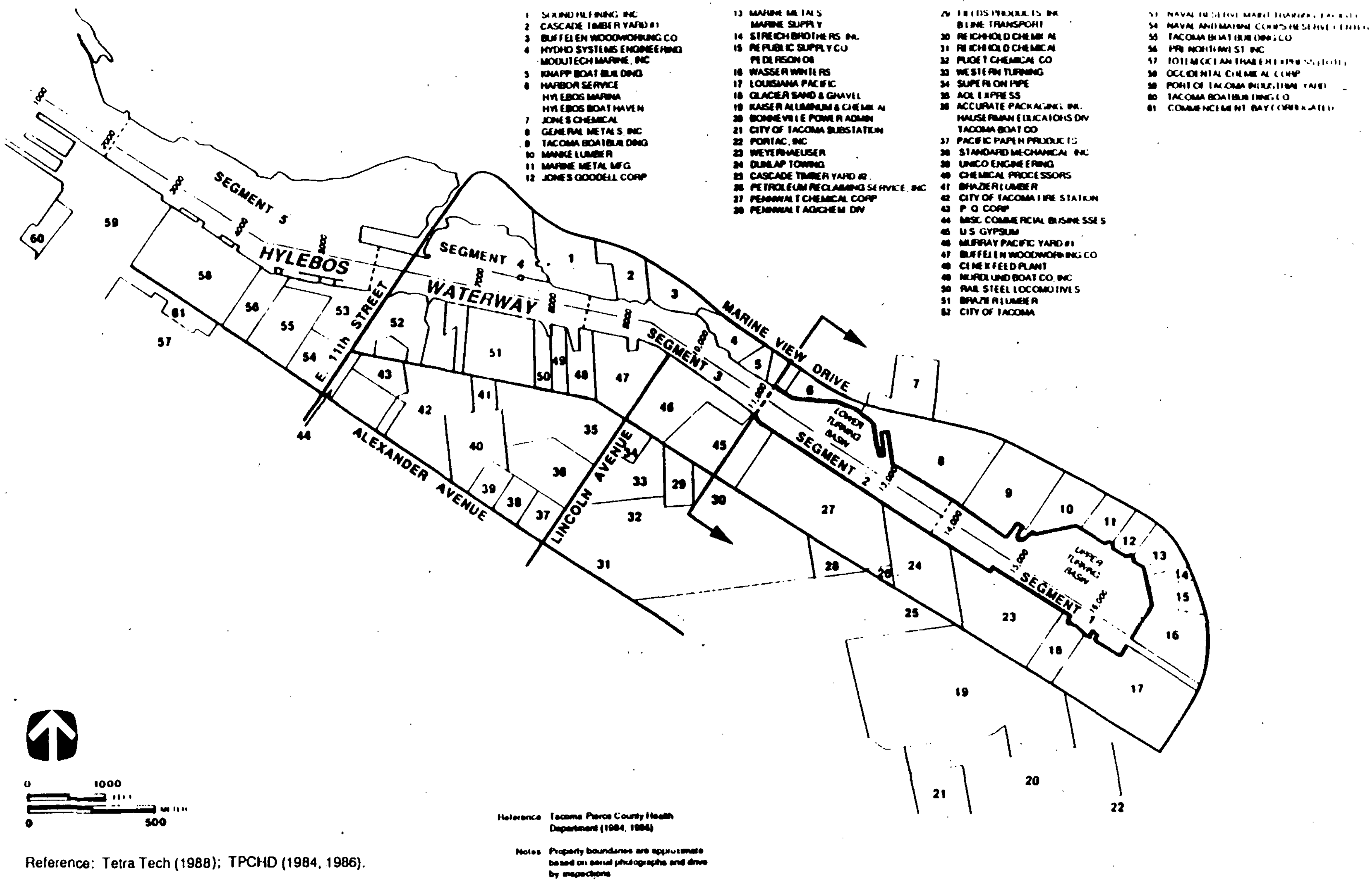


Figure C-1. Recent, ongoing, and planned activities at the Head of Hylebos Waterway



Reference: Tetra Tech (1988); TPCHD (1984, 1986).

Figure C-2. Hylebos Waterway - Existing industries and businesses

Remedial activities at Pennwalt Chemical Corporation are regulated by both a consent decree signed in July 1987 and a stipulated agreement issued in March 1989. The decree requires the following:

- Characterization of the Pennite area (sludge, soil, and shallow groundwater)
- Characterization of the Wypenn area (soil and groundwater)
- Surface impoundment sampling and analysis
- Surface water quality sampling and analysis
- Following completion of characterization of the Pennite area, preparation of recommendations for mitigating arsenic contamination in the upper aquifer and implementation of the approved alternative.

Soil sampling and analysis plans for the Wypenn and Pennite areas were submitted in December 1987, and soil sampling at the Pennite area was completed in early 1988. The Wypenn soil sampling plan was approved in May 1989. The surface water quality and impoundment sampling plans were submitted to Ecology in August 1987. These plans were revised in May 1989 and will be completed by October 1989. A groundwater characterization report and an engineering evaluation work plan to mitigate arsenic contamination in the upper aquifer in the vicinity of the Pennite area were submitted in December 1987. The arsenic remediation feasibility study/remedial design work plan was approved in May 1989, and a completed feasibility study/remedial design for the Pennite area is expected in February 1990. Remedial action should begin in spring 1990 and require 1 year to complete. Construction on a new caustic tank farm facility began in January 1989 and will be finished in October 1989.

An administrative order issued in February 1988 addresses the extreme pH variations in the Pennwalt effluent. The order requires that Pennwalt either comply with dangerous waste permit-by-rule regulations or meet the exemption requirements. The administrative order has been superseded by a stipulated agreement signed in March 1989. Under the stipulated agreement, Pennwalt must meet the following requirements:

- Pay penalties for pH exceedance in the outfall
- Make interim and final upgrades to the pH neutralization system.

The interim neutralization system has been in place and operating effectively since June 1989. The final neutralization system must be operable prior to an NPDES permit renewal in August 1990.

No ongoing sources of polychlorinated biphenyls (PCBs) were identified in the CB/NT remedial investigation at General Metals, Inc. However, a subsequent PCB reconnaissance survey completed in July 1986 found elevated levels of PCBs (Stinson et al. 1987). Activities at the site are being conducted under an Ecology administrative order issued in August 1987 that requires General Metals to remove inactive PCB transformers and submit a work plan for complete site characterization. In February 1988, a work plan for site characterization and interim remedial action was submitted, and the order was amended to require that a conceptual site drainage plan be submitted and that source control remedial action be initiated. The preliminary remedial investigation was conducted between March and July 1988 and the continuing remedial investigation was submitted to Ecology in June 1989. A site stabilization plan was submitted to Ecology in September 1988, and Ecology amended the order to require implementation of the plan and preparation of a source control feasibility study. The source control feasibility study began in December 1988 and was completed in July 1989. Further source control activities after December 1989 will be enforced by an agreement or order which should be signed in October 1989. Various types of site stabilization activities began in March 1988 and continued until June 1989.

Remedial actions at the 3009 Taylor Way log sorting yard are regulated by a consent order signed in June 1987 between Ecology and the Pennwalt Chemical Corporation (the property owner). The order requires Pennwalt to prepare an engineering evaluation (surface water investigation) and conduct a remedial investigation/feasibility study at the site. Work plans for an engineering evaluation and a remedial investigation/feasibility study were submitted to Ecology in July and August 1987, respectively. Between July 1987 and January 1988 the surface water investigation was completed. A focused feasibility study submitted in March 1988 indicated that interim remedial action would not be required. Ecology has concurred with this conclusion and determined that remedial action will await the results of the remedial investigation/feasibility study. The remedial investigation work plan was approved in December 1987, and the remedial investigation began in February 1988. Between February and March 1988, the hazardous substances and hydrogeological investigations were completed. Wet weather sampling was completed in the spring of 1988. The submittal date of the final feasibility study is a negotiated item under the 1987 consent order. The remedial design/remedial action phase will be handled by either an amended or a new consent decree. The new consent decree will be consistent with the applicable or relevant and appropriate requirements (ARARs) of the Model Toxics Control Act and should be signed during the summer of 1990.

Activities at the Wasser Winters log sorting yard are regulated by a consent order, signed in March 1987, between Ecology and the Port of Tacoma (the property owner). A preliminary site characterization was completed in April 1987. In August 1987, a proposal by the Port of Tacoma to mitigate soils slag and wood waste onsite was submitted to Ecology and rejected. In January 1988, the Port of Tacoma agreed to prepare a proposal for an alternative remedial design incorporating mitigation of both surface water and groundwater contamination. This remedial design should be finished by February 1990. Remedial action should begin in March 1990 and be completed by December 1990.

Ecology issued an administrative order in June 1987 that requires Louisiana-Pacific log sorting yard to perform a site investigation and feasibility study. A surface water drainage study was completed in October 1987. A work plan for groundwater characterization was submitted by the PRP in November 1988. Groundwater characterization, which began in September 1988, includes installation of three monitoring wells, one round of sampling, and a tidal study. Groundwater sampling will be followed by groundwater monitoring. The feasibility study work plan was submitted to Ecology in January 1988, the draft feasibility study was submitted in September 1988, and the final feasibility study was submitted in February 1989. An addendum to the feasibility study was completed by Ecology in June 1989 to address several issues of concern not previously addressed. Remedial action should begin in June 1990 and be completed by October 1990.

Remedial action at Cascade Timber Yard #2 is regulated by the Puyallup Tribe settlement agreement. It is anticipated that this agreement will become effective in February 1990. Under the agreement, the Port of Tacoma must perform an environmental audit and prepare a cleanup plan. The environmental audit began in April 1989, and the sampling plan section of this audit will begin in October 1989. The Port of Tacoma has 3 years from the effective date of the agreement to complete the cleanup.

Remedial action at B&L Landfill is driven by a consent decree completed in February 1989. The consent decree requires a remedial investigation/feasibility study/remedial design by May 1990. The final remedial investigation should be completed in early 1990. Under an extension currently being negotiated, the final remedial action/remedial design will be completed in June 1990. The remedial action will require an amended or new consent decree. Of the nine PRP that have been identified, one PRP (Murray Pacific) has agreed to complete the remedial action if 30 percent matching public funds are provided.

Remedial activities at Tacoma Boatbuilding Company are driven by the Shipyard Education Program and the related NPDES permits being issued by Ecology and an administrative order effective July 1989. The Shipyard Education Program, currently underway, is designed to provide shipyard operators with information on appropriate best management practices. The NPDES permit will be issued in December 1989. The NPDES permit and the administrative order will require that best management practices be implemented, monitored, and documented. Best management practices will include routine cleaning of the yard area; appropriate storage of paints, solvents, and other chemicals; the use of drip pans and containment structures to minimize dispersion of potentially hazardous solutions and dust; constraints on bilge and ballast water discharge; and explicit limitations on the discharge of all oil or hazardous material to the waterway.

USG Landfill has been associated with contamination in sediments at the Head of Hylebos Waterway but is not specifically included in the schedules because of a lack of recent activity. Remedial actions at USG Landfill are mainly historical and include excavation and removal of waste and capping of the site. Groundwater at the site is currently monitored, and no additional remedial activities are scheduled.

MOUTH OF HYLEBOS WATERWAY

The locations of existing industries, businesses, and discharges in Hylebos Waterway are shown in Figure C-2. Remedial activities at the Mouth of Hylebos Waterway are summarized in Figure C-3. Occidental Chemical is the major identified source of problem chemicals in this problem area. Several source control actions have been undertaken by Occidental Chemical in the past several years. In-plant modifications include the installation of taller chlorine stripping towers along with modifications in temperature regulation and modified waste handling practices. Effluent from the facility is monitored under an NPDES permit, which is due for renewal in March 1990. Most of the soil characterization was conducted in 1979. More than 10,000 cubic yards of soil contaminated with chlorinated organic compounds were removed from the site during 1981-1982, in accordance with a consent order.

Recent, ongoing, and planned activities at Occidental Chemical are driven by a Resource Conservation and Recovery Act (RCRA) Part B permit that specifies sediment sampling and sediment and groundwater remediation. The draft RCRA permit was completed in August 1988. The permit was completed in November 1988. Groundwater monitoring is ongoing, and the installation of six additional shallow wells was completed in September 1988. A sediment sampling plan approved by the U.S. Environmental Protection Agency (EPA) and Ecology in December 1987 is being implemented and a draft report will be completed by September 1989. Also expected in September 1989 is a draft groundwater corrective action plan for a groundwater extraction and treatment system. Construction on the extraction and treatment systems should begin early in 1991 and require a minimum of 8 months to complete.

SITCUM WATERWAY

The locations of existing industries, businesses, and discharges in Sitcum Waterway are shown in Figure C-4. Remedial activities in Sitcum Waterway are directed at Terminal 7 ore unloading facilities and Storm Drain SI-172, two primary sources of metals (Figure C-5). Remedial actions at Terminal 7 are limited to the implementation of best management practices. Spilled ore, which was formerly swept into the waterway, is now collected and sold to smelters. A closed conveyer belt is now used for transferring alumina ore from ships to storage areas. Best management practices are subject to routine monitoring to ensure that discharge of ore to the waterway is minimized. Routine monitoring (conducted as of July 1989) indicates that best management practices are being followed.

Storm Drain SI-172 is one of five storm drains in the CB/NT area included in the pollution control effort being implemented under the memorandum of agreement between Ecology, the city of Tacoma, and the Tacoma-Pierce County Health Department (TPCHD). The storm drain report required by the agreement was completed in July 1989. Between January 1987 and December 1988, chemical loading from the drain was monitored quarterly during high- and low-flow conditions. Also during this study period, business inspections were conducted to better characterize activities

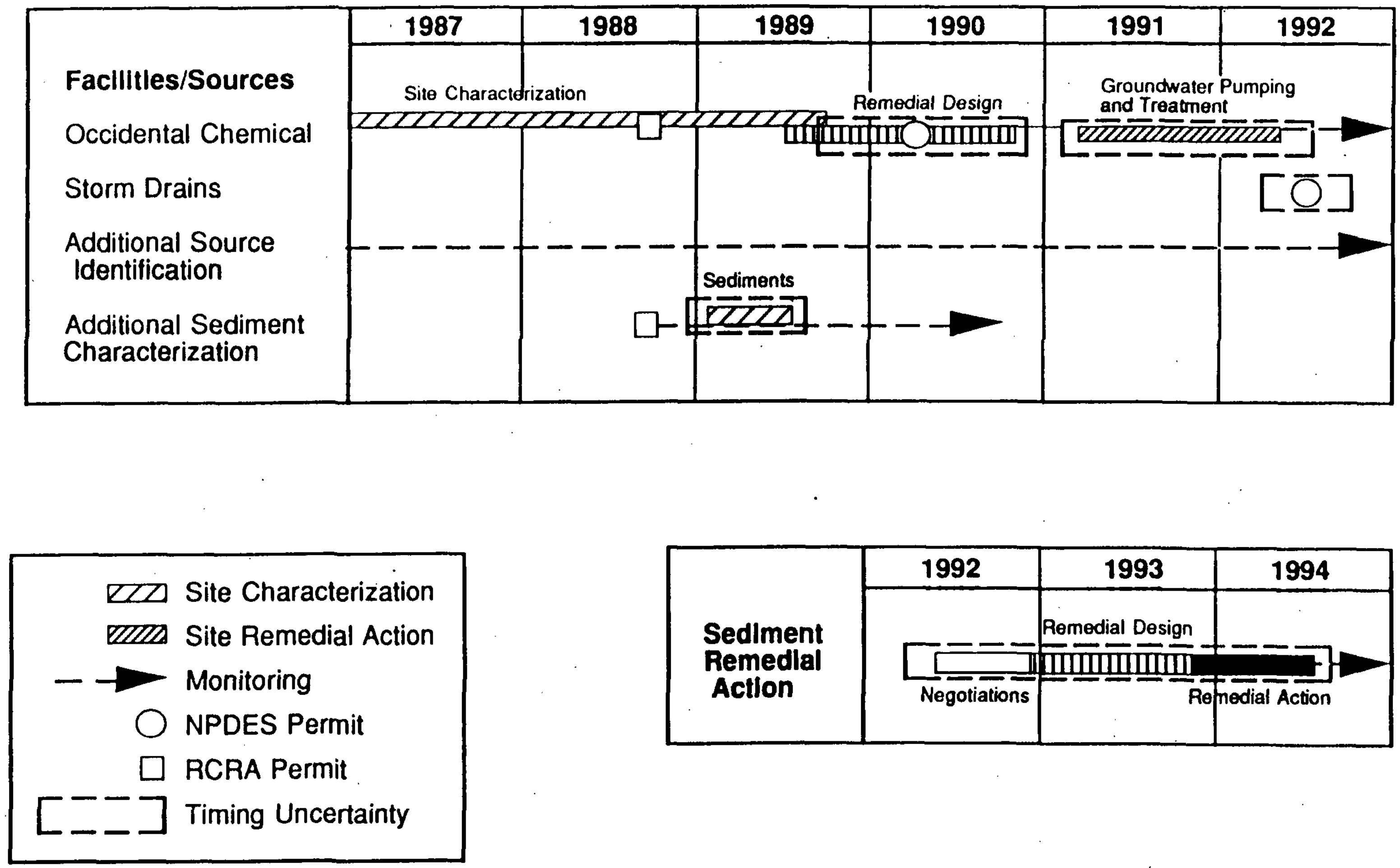
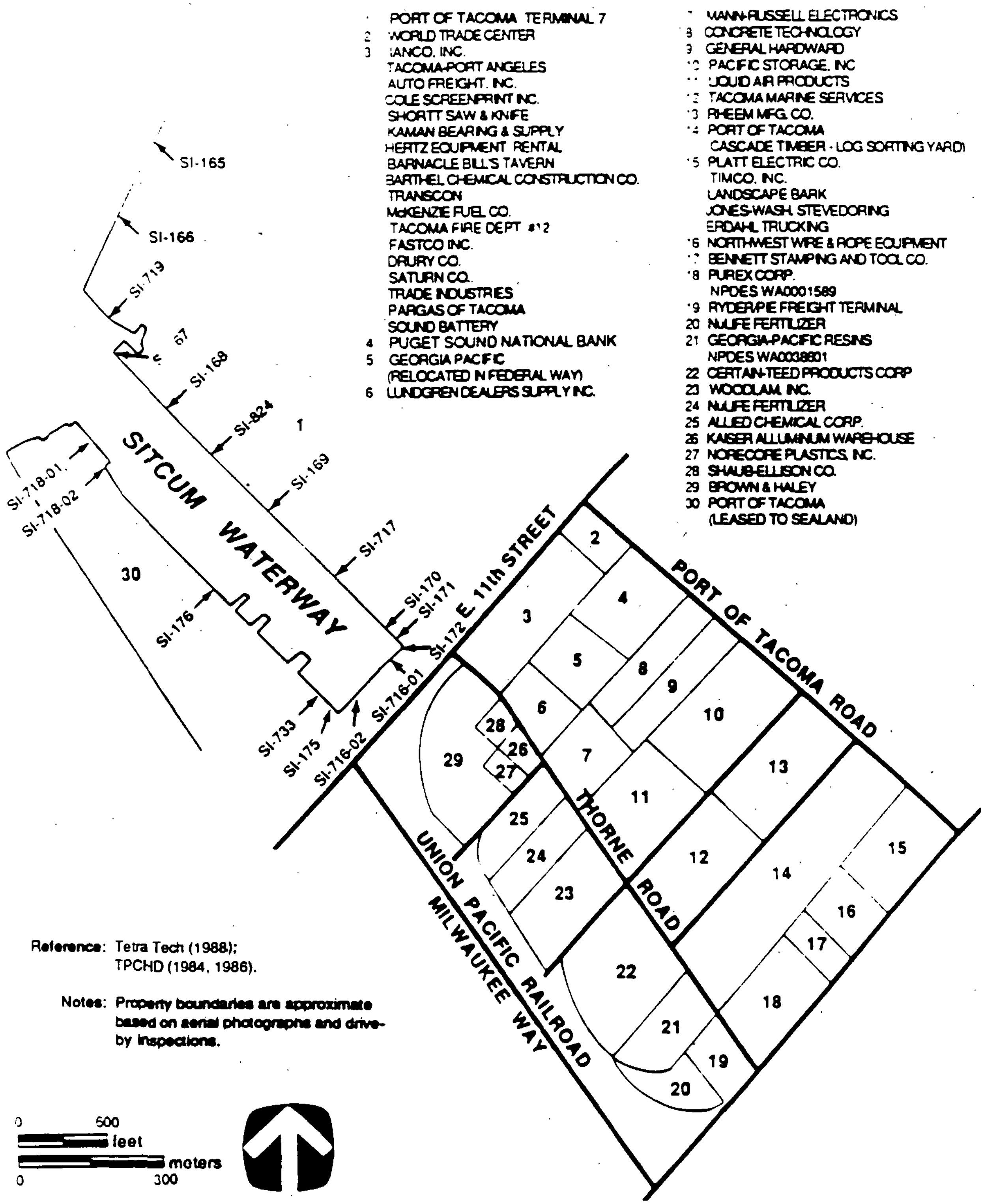


Figure C-3. Recent, ongoing, and planned activities at the Mouth of Hylebos Waterway



Reference: Tetra Tech (1988); TPCHD (1984, 1986).

Notes: Property boundaries are approximate based on aerial photographs and drive-by inspections.

Figure C-4. Sitcum Waterway - Existing industries, businesses, and discharges

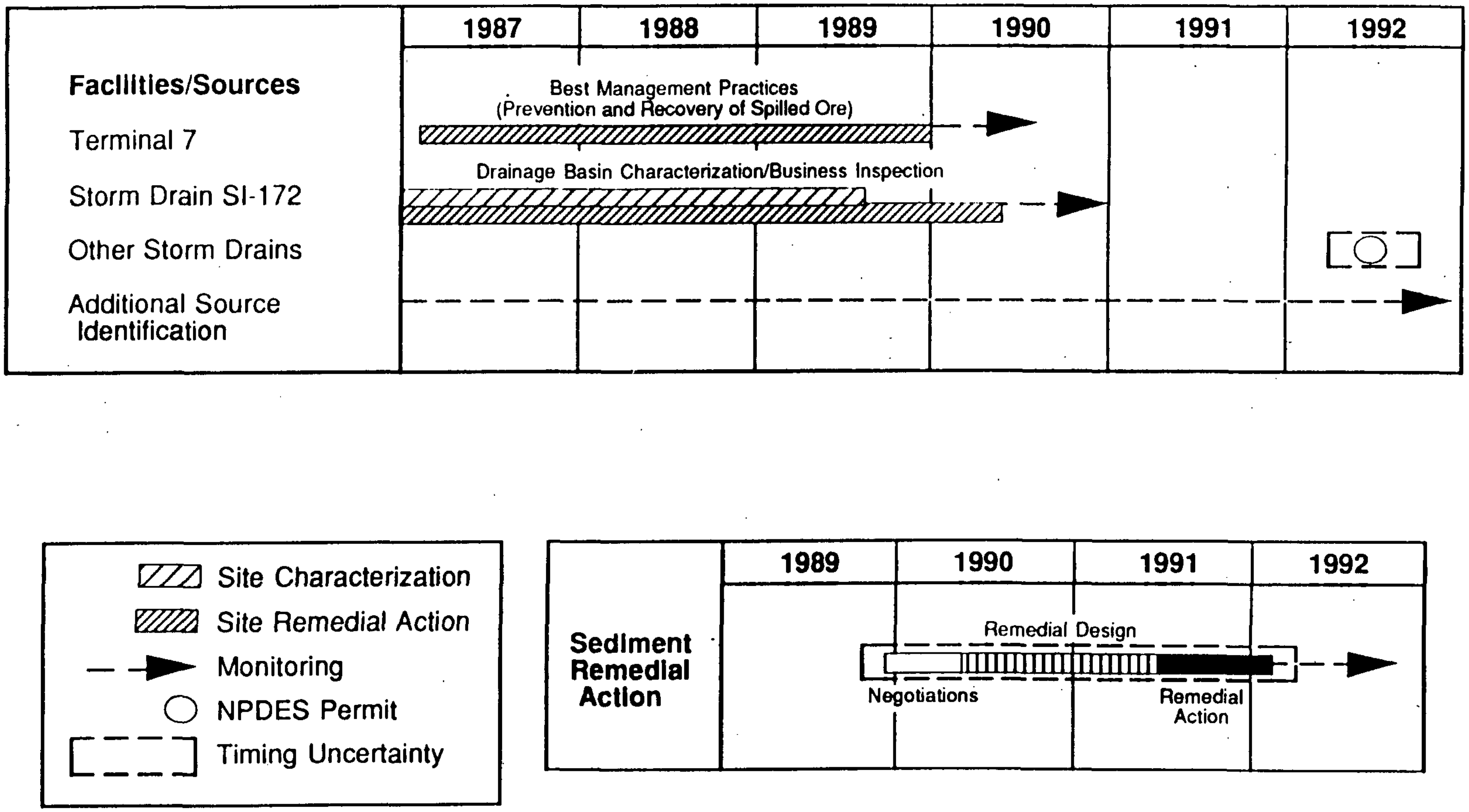


Figure C-5. Recent, ongoing, and planned activities in Sitcum Waterway and implement appropriate corrective actions. Business inspections and storm drain monitoring have been extended until April 1990.

Significant source controls in Sitcum Waterway have been implemented, but their effectiveness has not yet verified.

At the time of this writing, the Port of Tacoma has plans to dredge over 40,000 cubic yards of material for maintenance and extension of Pier 1. Habitat replacement at the head of the waterway and a fish mitigation area are elements of the planned dredging. The navigational channel in Sitcum Waterway is also subject to routine dredging. Where possible, these dredging projects will be integrated into the implementation of the preferred sediment remedial alternative. Re-evaluation of the dredging schedule and resource availability may necessitate modification of the schedule for sediment remedial action.

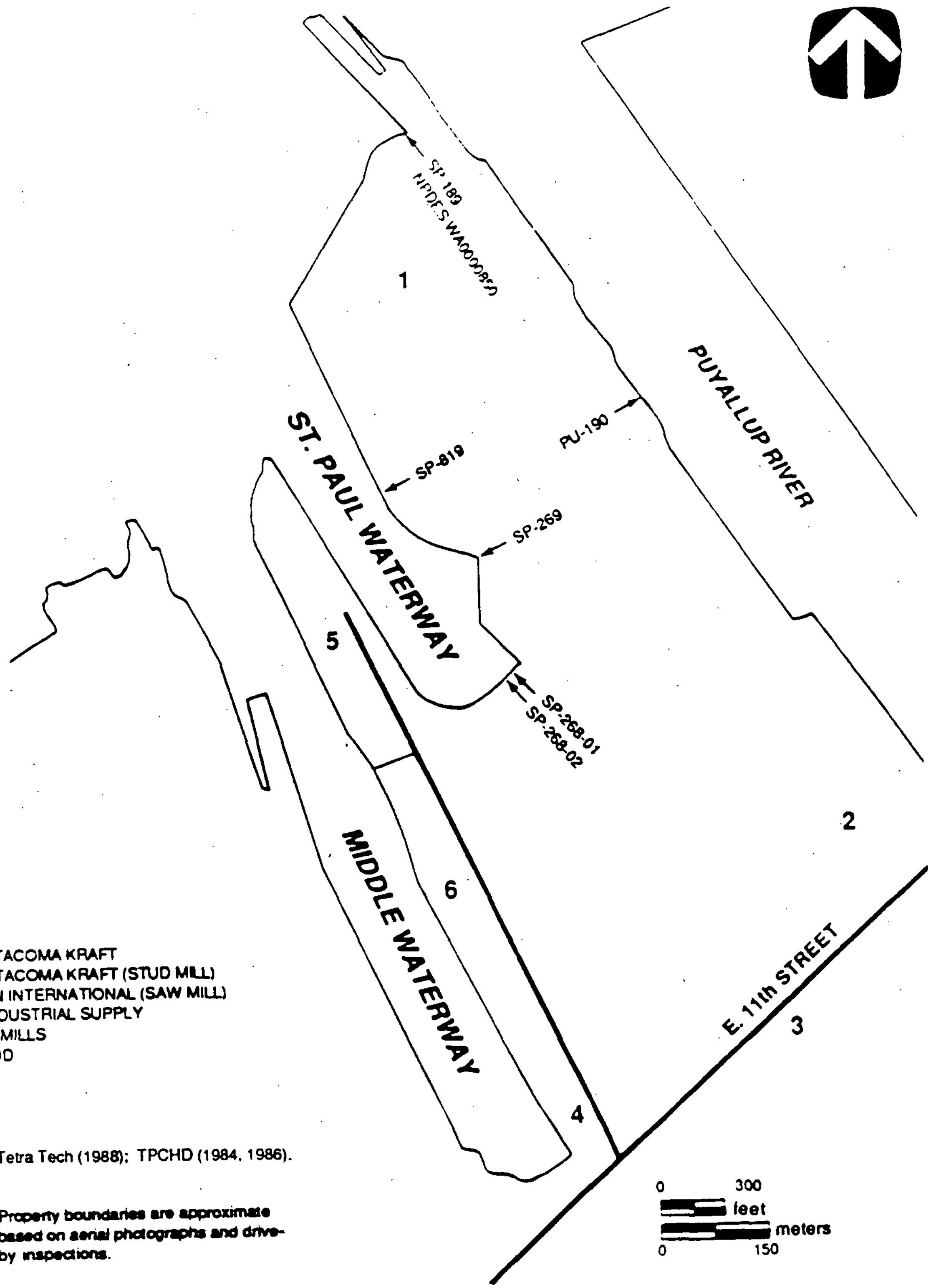
ST. PAUL WATERWAY

The locations of existing industries, businesses, and discharges in St. Paul Waterway are shown in Figure C-6. Remedial activities are more advanced in St. Paul Waterway than in any other problem area. Simpson Tacoma Kraft pulp mill, the waterway's single major source of problem chemicals, has implemented numerous source control actions, including outfall relocation, process modifications, and best management practices. Recent, ongoing, and scheduled activities associated with the site are summarized in Figure C-7. Activities at the Simpson Tacoma Kraft pulp mill are driven by an order issued by Ecology in December 1985 and a consent decree signed in December 1987. The relocation of the treatment plant outfall required by the December 1985 order was completed in March 1988. Simpson also has initiated a remedial action and habitat restoration program in an effort to remediate sediments previously contaminated by waste discharged from the site. Under the December 1987 consent decree, Simpson has deposited sediments displaced during relocation activities in a shallow depression near the original outfall location. Capping of this and other sediments contaminated by historical discharge from the plant was conducted between July and September 1988. A habitat restoration program designed to mitigate adverse biological impacts was a key element of capping activities. The Simpson Tacoma Kraft Company is required under the December 1987 decree to monitor the long-term effectiveness of the capping and habitat restoration activities.

The effluent from the Simpson Tacoma Kraft pulp mill is monitored under an NPDES permit that is scheduled for renewal in December 1989. At that time, the permit may be modified to expand restrictions on toxic chemicals not previously covered in the permit and to incorporate additional monitoring requirements.

MIDDLE WATERWAY

The locations of existing industries, businesses, and discharges in Middle Waterway are shown in Figure C-8. Remedial activities in Middle Waterway have focused on two potential sources of metals, Marine Industries Northwest and Cooks Marine Specialties (Figure C-9). Remedial activities at these shipyards are driven by the Shipyard Education Program and related NPDES permits that are being implemented by Ecology. The Shipyard Education Program (currently underway) is designed to disseminate appropriate best management practices to shipyard operators. NPDES permits to be issued to these sites in December 1989 will require that best management practices be implemented and documented by monitoring. Best management practices covered in the permit will include routine cleaning of the yard area; appropriate storage of paints, solvents, and other chemicals; the use of drip pans and containment structures to minimize dispersion of potentially hazardous solutions and dust; and constraints on bilge and ballast water discharge. The permits will also include explicit limitations on the discharge of all oil and hazardous material to the waterway.



1 SIMPSON TACOMA KRAFT
2 SIMPSON TACOMA KRAFT (STUD MILL)
3 CHAMPION INTERNATIONAL (SAW MILL)
4 MORSE INDUSTRIAL SUPPLY
5 PAXPORT MILLS
6 WELLWOOD

Reference: Tetra Tech (1988); TPCHD (1984, 1986).

Notes: Property boundaries are approximate based on aerial photographs and drive-by inspections.

Figure C-6. St. Paul Waterway - Existing industries, businesses, and discharges

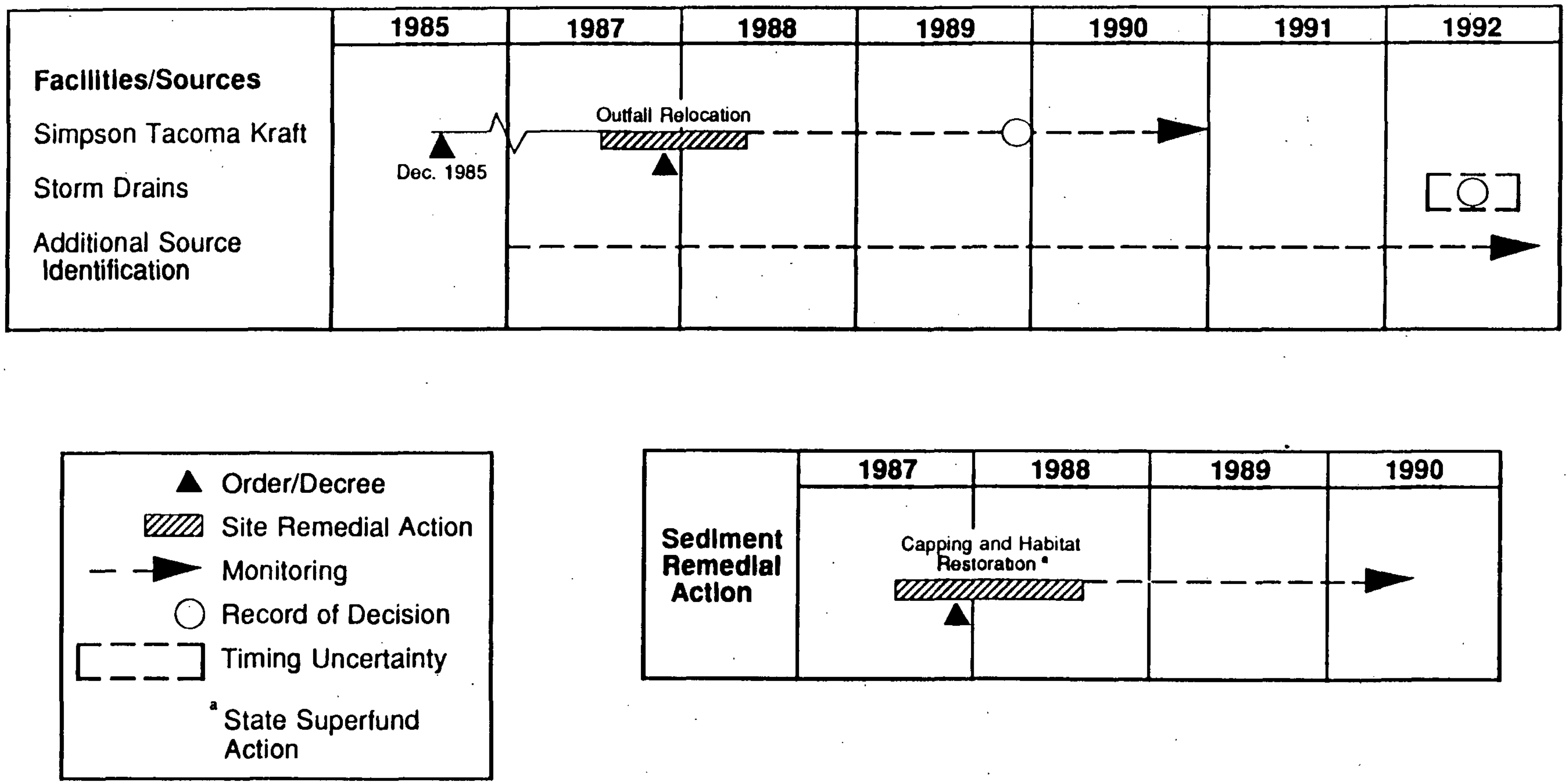
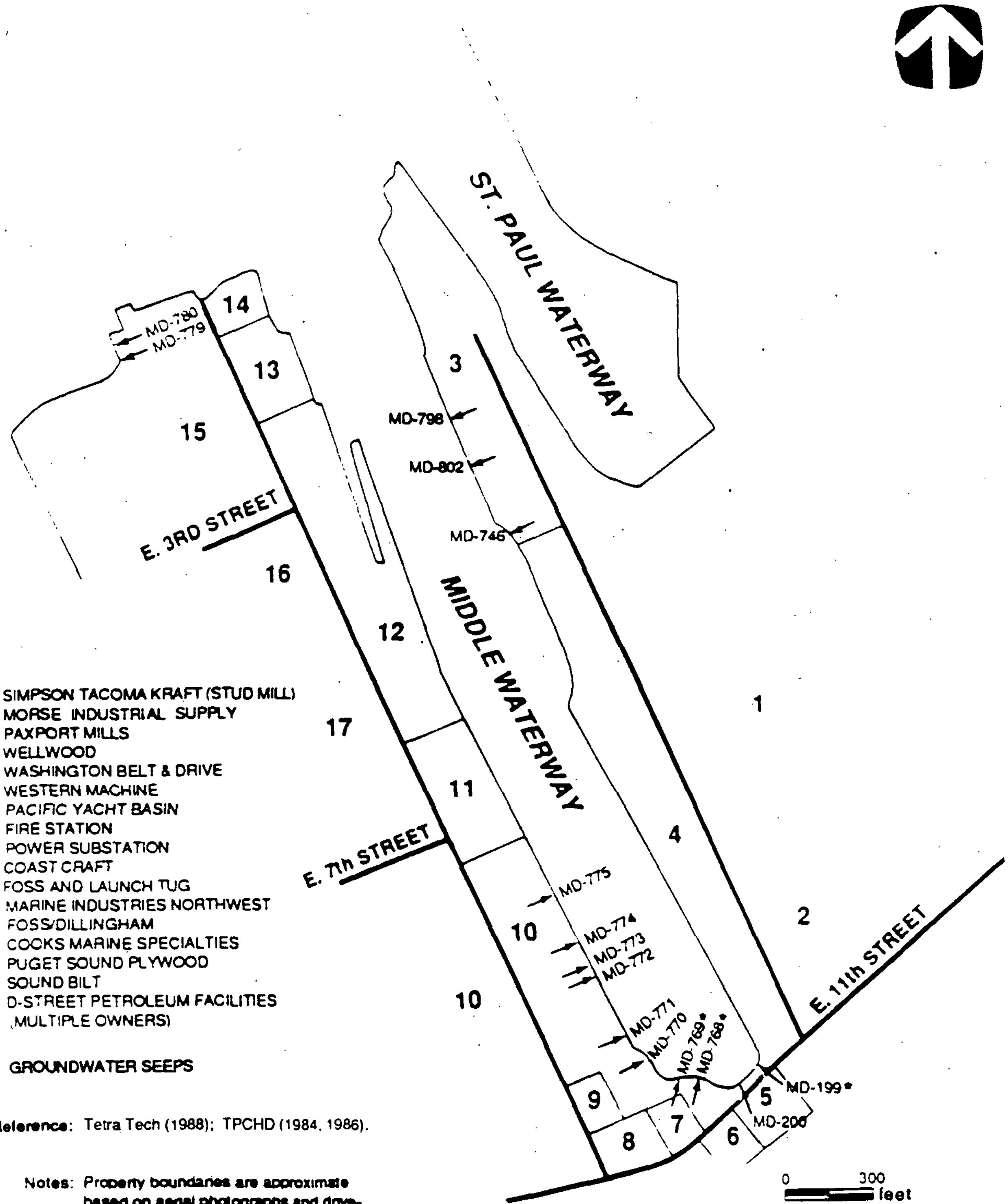


Figure C-7. Recent, ongoing, and planned activities in St. Paul Waterway



1 SIMPSON TACOMA KRAFT (STUD MILL)
2 MORSE INDUSTRIAL SUPPLY
3 PAXPORT MILLS
4 WELLWOOD
5 WASHINGTON BELT & DRIVE
6 WESTERN MACHINE
7 PACIFIC YACHT BASIN
8 FIRE STATION
9 POWER SUBSTATION
10 COAST CRAFT
11 FOSS AND LAUNCH TUG
12 MARINE INDUSTRIES NORTHWEST
13 FOSS/DILLINGHAM
14 COOKS MARINE SPECIALTIES
15 PUGET SOUND PLYWOOD
16 SOUND BILT
17 D-STREET PETROLEUM FACILITIES (MULTIPLE OWNERS)

* GROUNDWATER SEEPS

Reference: Tetra Tech (1988); TPCHD (1984, 1986).

Notes: Property boundaries are approximate based on aerial photographs and drive-by inspections.

Figure C-8. Middle Waterway - Existing industries, businesses, and discharges

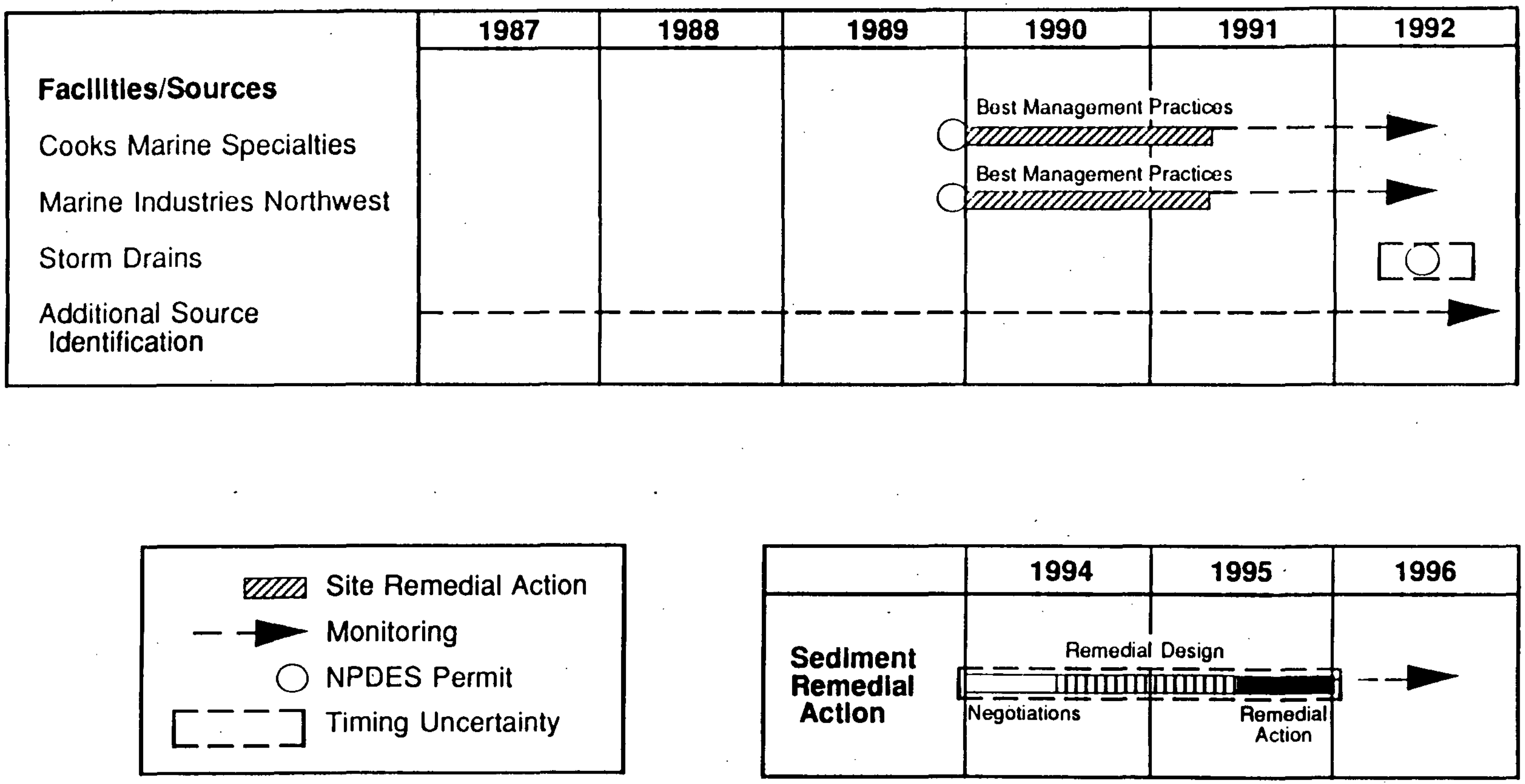


Figure C-9. Recent, ongoing, and planned activities in Middle Waterway

Storm Drain MD-200 was identified as a probable source of lower priority organic chemicals at the head of the waterway. Sediments in Storm Drain MD-200 were sampled in June 1987 and analyzed for problem chemicals. Remedial activities associated with Storm Drain MD-200 and other storm drains in Middle Waterway will be regulated by the new NPDES permit regulations that should be adopted in early 1990.

It is uncertain whether all major ongoing sources of contamination to Middle Waterway have been identified. The effectiveness of the best management practices implemented at the shipyards has not been verified. Between October 1989 and June 1990, inspections are schedule for Foss and Launch Tug Industries, Coast Craft, Paxport Mills, and Puget Sound Plywood. However, there is currently no indication that any of these businesses is a source of pollution to Middle Waterway.

HEAD OF CITY WATERWAY

The locations of existing industries and businesses in City Waterway are shown in Figure C-10. Remedial actions are underway for several of the sources that have been associated with problem chemicals in sediments at the Head of City Waterway (Figure C-11). City Waterway Marina, Inc. and Martinac Shipbuilding have plans to dredge in the near future. The navigational channel running the length of City Waterway is also subject to routine dredging. When possible, remedial action implementation will be coordinated with planned dredging within the waterway. Major sources of problem chemicals include: Storm Drains CS-237, CN-237, and CI-230 (e.g., metals and high molecular weight polycyclic aromatic hydrocarbons); Martinac Shipbuilding (metals only); and American Plating (primarily nickel).

American Plating is no longer an active facility. When active, the site was designated an RCRA dangerous waste generator. After the site became inactive, Ecology negotiated consent orders to mitigate contamination problems onsite. Emergency site stabilization at American Plating was performed by the site owner under a November 1986 consent order and was completed in June 1987. A second consent order signed in September 1987 stipulates additional site characterization, including 1) the chemical and spatial characterization of remaining waste onsite, 2) determination of the integrity of sumps, and 3) groundwater monitoring. In September 1987, EPA issued a RCRA enforcement order.

Ongoing remedial action at the site is driven by the RCRA closure process and the state Superfund law. A remedial investigation work plan was submitted to Ecology and EPA in February 1988 and was approved in April 1988. The draft remedial investigation report was submitted in July 1988. However, a preliminary review revealed several data gaps, particularly in the characterization of the vertical extent of soil contamination. An acceptable remedial investigation report was received in May 1989. The RCRA corrective action order is expected by October 1989. A corrective measures study will begin once the corrective action order is finalized in October 1989. The remedial action should begin during the summer of 1990 and require 6 months to complete.

Remedial activities at Martinac Shipbuilding are driven by the Shipyard Education Program and the related NPDES permits being implemented by Ecology. The Shipyard Education Program (currently underway) is designed to disseminate appropriate best management practices to shipyard operators. NPDES permit applications to be finalized in January 1990 will require that best management practices be implemented and documented by monitoring. Best management practices covered in the permit will include routine cleaning of the yard area; appropriate storage of paints, solvents, and other chemicals; the use of drip pans and containment structures to minimize dispersion of potentially hazardous solutions and dust; and constraints on bilge and ballast water discharge. The permit will also include explicit limitations on the discharge of all oil and hazardous material to the waterway.

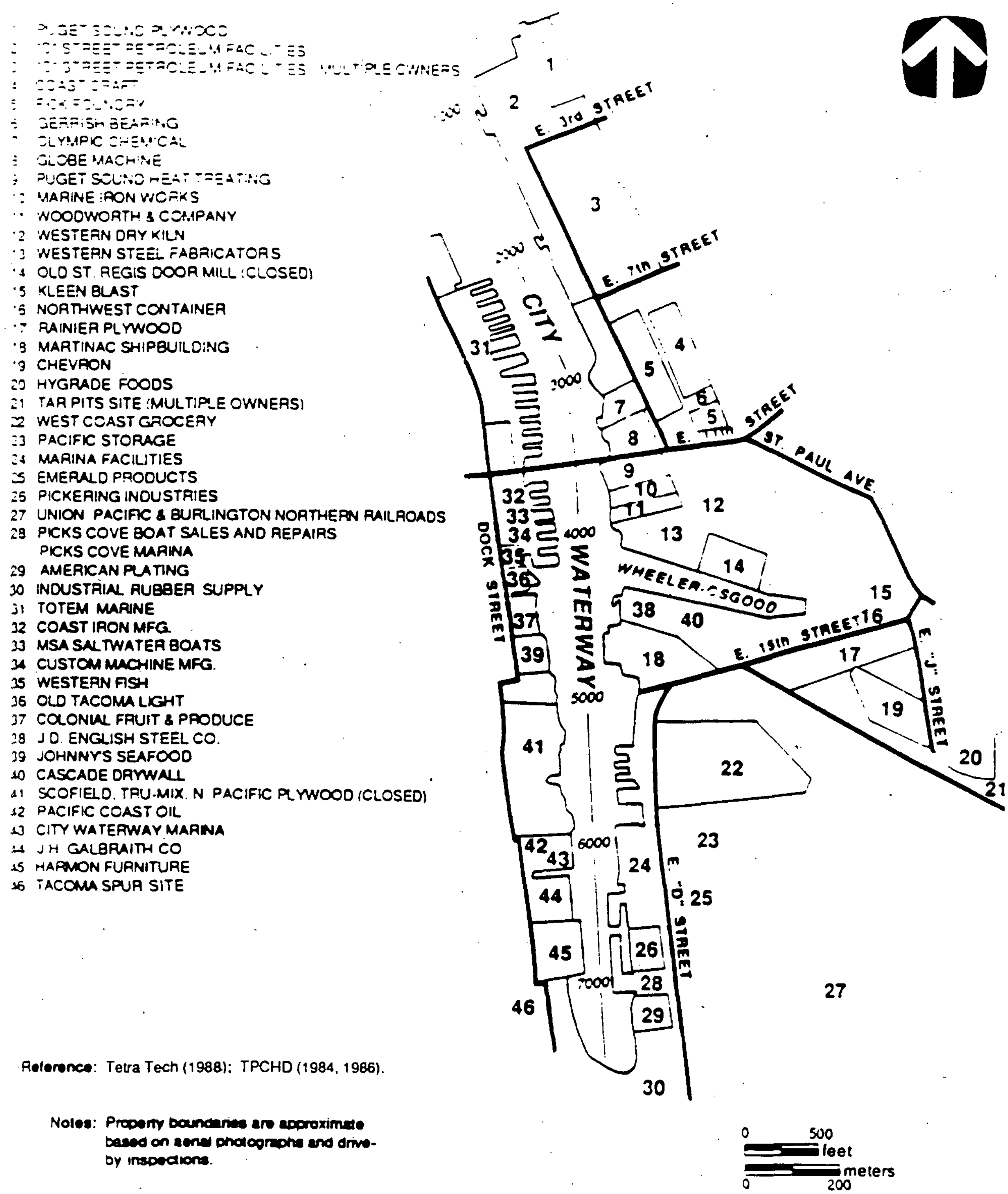


Figure C-10. City Waterway - Existing industries, businesses, and discharges

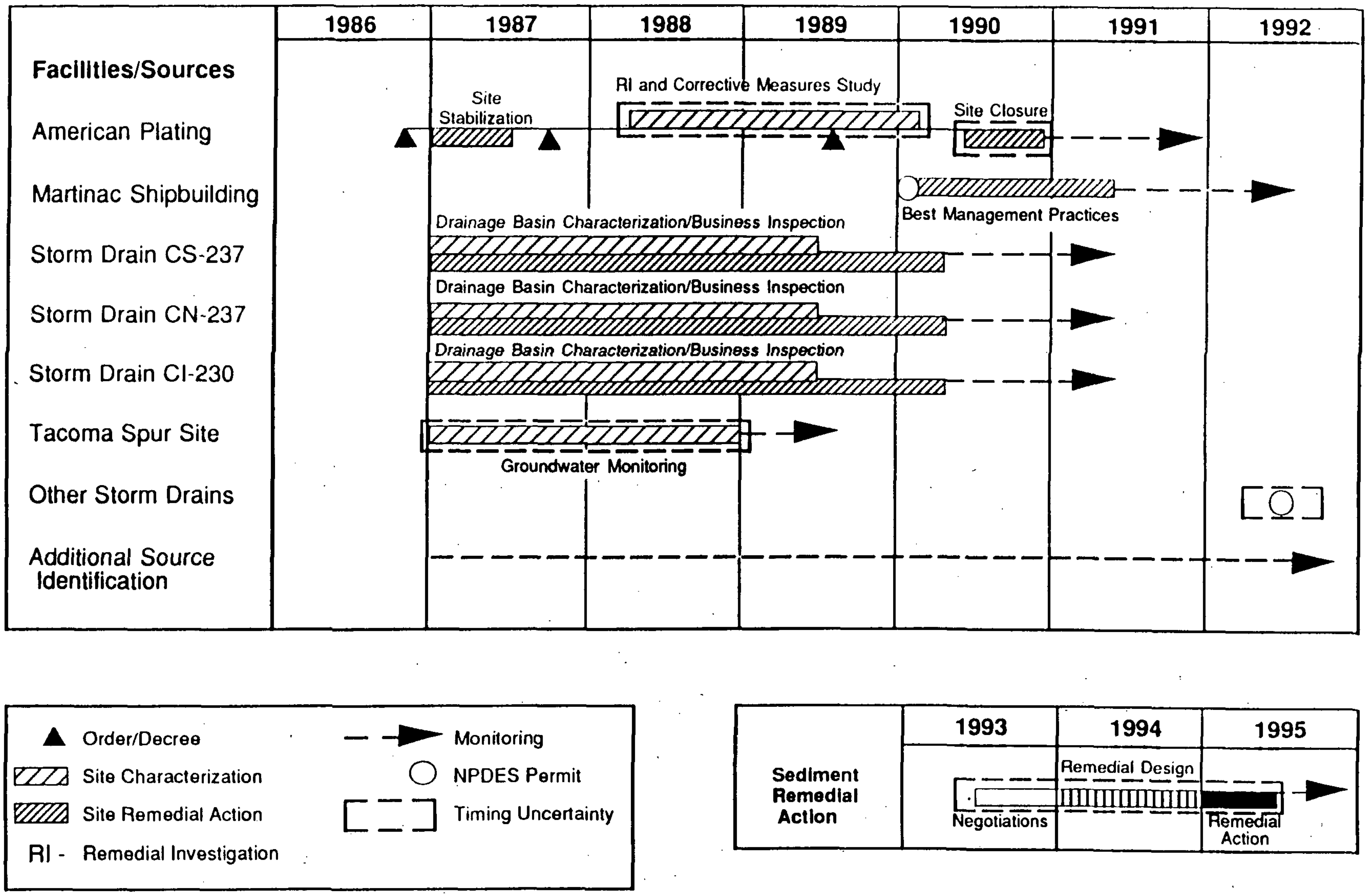


Figure C-11. Recent, ongoing, and planned activities at the Head of City Waterway

Groundwater monitoring is currently being conducted at the Tacoma Spur site. Approximately 17,500 tons of contaminated soils were removed from the site during highway construction. However, no additional remedial action is planned.

Storm Drains CS-237, CN-237, and CI-230 are three of the five CB/NT storm drains included in the pollution control effort being implemented under a memorandum of agreement between Ecology, the city of Tacoma, and the TPCHD. The storm drain report required by the agreement was completed in July 1989. Between January 1987 and December 1988, chemical loading from the drain was measured quarterly for high- and low-flow conditions. Business inspections have been conducted within the drainage basin during this study period to better characterize activities and implement appropriate corrective actions. Monitoring activities have been extended to April 1990. The Tacoma sewer utility is evaluating the feasibility of sediment detection basins to control contaminant discharge into the waterway from Storm Drains CN-237 and CS-237. A report on the sediment detention evaluation will be completed in October 1989.

WHEELER-OSGOOD WATERWAY

The locations of existing industries and businesses in Wheeler-Osgood Waterway are shown in Figure C-10. Remedial activities in Wheeler-Osgood Waterway are summarized in Figure C-12. Storm Drain CW-254 has been identified as the waterway's major ongoing source of problem chemicals. Storm Drain CW-254 is one of five storm drains included in the pollution control effort being implemented under a memorandum of agreement between Ecology, the city of Tacoma, and the TPCHD. The storm drain report required by the agreement was completed in July 1989. Between January 1987 and December 1988, chemical loading from the drain was monitored quarterly for high-and low-flow conditions. Also during this study period, business inspections are conducted within the drainage basin to better characterize activities and implement appropriate corrective actions. Quarterly sampling of the drain has been extended to April 1990.

A separate environmental audit was voluntarily undertaken by Chevron at its bulk plant facility between January and March 1989. The audit indicates that drill cuttings at the site are a source of total petroleum hydrocarbons. A voluntary full-scale investigation and cleanup by Chevron is anticipated.

MOUTH OF CITY WATERWAY

The locations of existing industries and businesses in City Waterway are shown in Figure C-10. Remedial activities at the Mouth of City Waterway are summarized in Figure C-13. The D Street petroleum facilities are an identified source of LPAH in the sediments in this problem area. A trench recovery system was installed as an interim remedial measure between September 1987 and January 1988. This system is expected to affect mainly the surface aquifer near Globe Machine; its effect on property farther north is unknown. Discharged product is also being recovered from wells on Globe Machine and Mobil properties. A consent order issued in November 1988 requires 1) interim remedial action at the site including floating product recovery (already underway) and leak detection/prevention, 2) a remedial investigation of soil, groundwater, surface water, and possibly sediment contamination, and 3) additional remedial action as appropriate.

The remedial investigation report submitted in June 1989 included recommendations that the following tasks be undertaken:

- Floating product plume mapping
- Dissolved contaminant sampling, analysis, and mapping
- Design of an upgraded effluent treatment system.

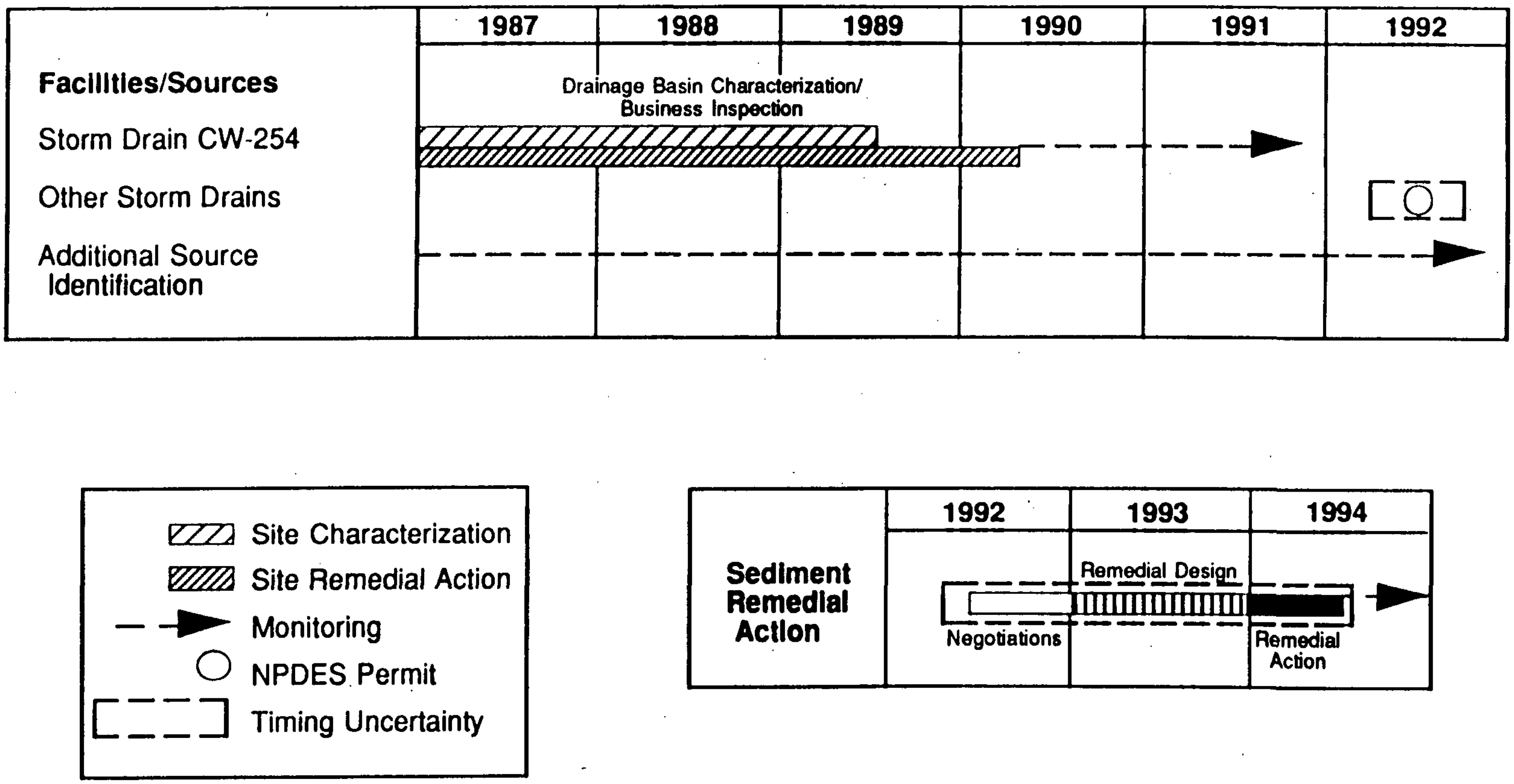


Figure C-12. Recent, ongoing, and planned activities in Wheeler-Osgood Waterway

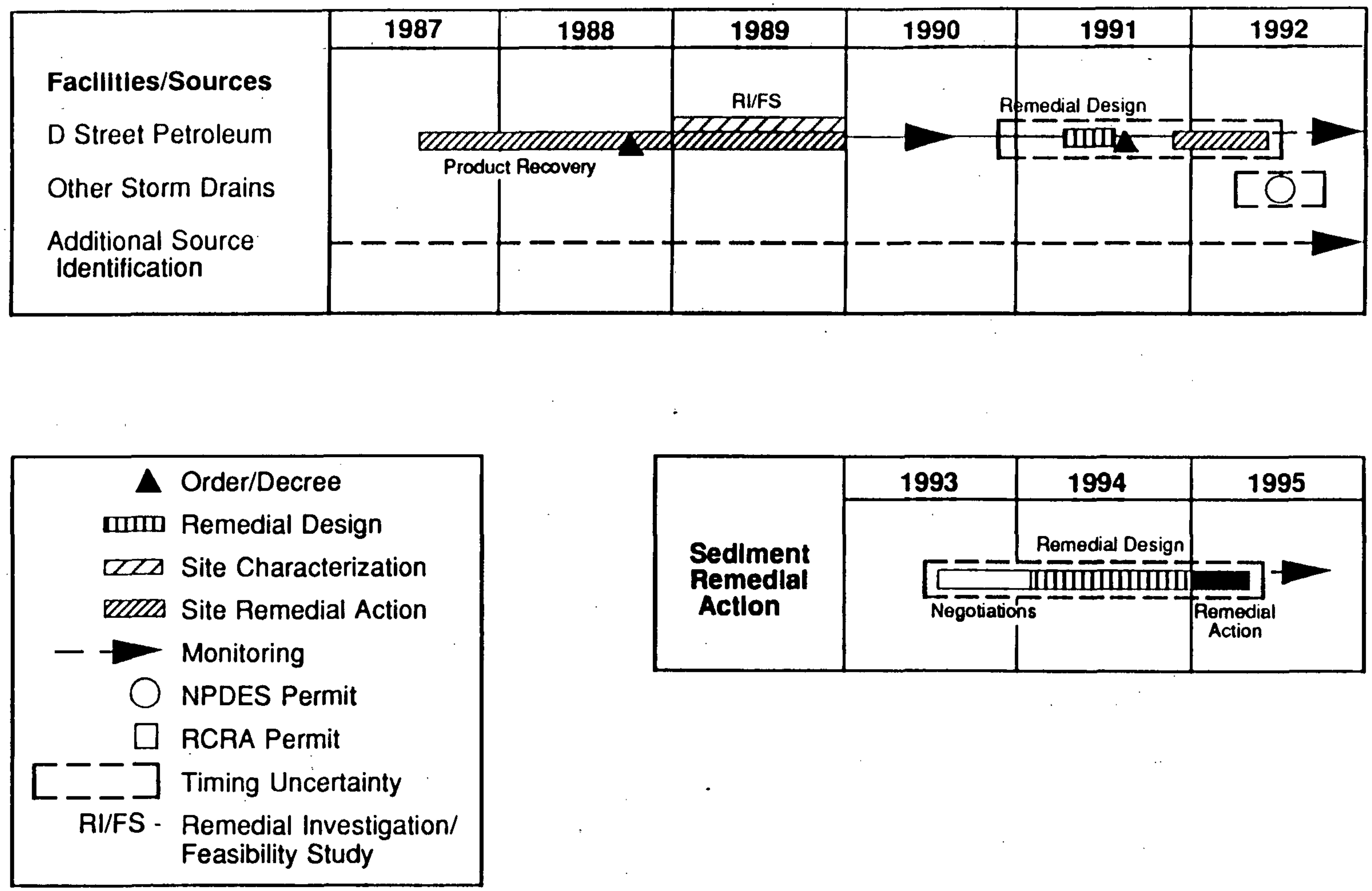


Figure C-13. Recent, ongoing, and planned activities at the Mouth of City Waterway

Under the consent order the feasibility study will be completed by December 1989, and the remedial design will be completed in November 1991 or 4 months after levels of free product removal drop below 20 gallons per day for 1 complete month. The remedial action will be conducted under an amended or a new consent order in compliance with the Model Toxics Control Act.

REFERENCES

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Stinson, M., D. Norton, and A. Johnson. 1987. An investigation into potential sources of PCB contamination in Hylebos Waterway. Washington Department of Ecology, Olympia, WA.

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TPCHD. 1986. Commencement Bay nearshore/tideflats area drainage system investigation. Tacoma-Pierce County Health Department, Tacoma, WA.

APPENDIX D

Revised Cost Estimate for Confinement Option

CONTENTS

LIST OF TABLES

REVISED COST ESTIMATE FOR CONFINEMENT OPTIONS

Revised cost estimates for the Commencement Bay/Nearshore Tideflats problem areas were prepared using principally the feasibility study (Tetra Tech 1988) as a source for unit costs and other factors (e.g., dredged deployment costs, production rates, sample analysis costs). Information presented by reviewers of the feasibility study suggested that some unit costs or other factors were questionable or erroneous. In these cases, these estimates were examined and revised in accordance with information presented by the reviewers or available from other sources. Each of the cost categories shown in Table D-1 is discussed below, including the value used, the rationale for its selection, and any special features of its application.

CORE SAMPLING FOR REMEDIAL DESIGN

A collection cost of $1,500 per core is used; this is the figure cited in the feasibility study (Tetra Tech 1988). The number of cores is presumed to be one per 4,000 cubic yards of sediment; this rate corresponds to the value used in the feasibility study and to PSDDA guidance for areas with the highest contamination ranking (PSDDA 1988).

CHEMICAL ANALYSIS FOR REMEDIAL DESIGN

Sample analysis costs differ with the problem area, according to the costs estimated in the feasibility study. These costs ranged from $800 to $1,500 per sample. Analysis of three samples from each core is presumed, in accordance with the feasibility study.

DESIGN/PERMITTING

The cost assigned to this category is $325,000 (Gershman, Brickner & Bratton 1989). The feasibility study does not include this cost category. *Confined Disposal of Contaminated Sediments, Documentation of Standards Development* (Parametrix 1989) recommends costs from $810,000 (for confined aquatic disposal) to $1,860,000 (for an upland mixed disposal site).

EQUIPMENT MODIFICATIONS

Equipment modifications for Commencement Bay sites consist of alterations to the clamshell bucket to make it watertight. The cost of $20,000 per clamshell, cited in the feasibility study, is used. Only one dredge at each problem area is presumed to be practical, hence the cost of one such modification is included for each problem area.

SITE ACQUISITION

Upland disposal is presumed to take place at one of the sites identified in U.S. Army COE (1985). Land costs in a commercial location are estimated to be $25,000 per acre. The total acreage required is computed as a function of the fill depth at the disposal site and the volume of material to be disposed of (after swelling and compaction).

TABLE D-1. COST CATEGORIES APPLICABLE TO EACH TYPE OF REMEDIAL ACTION

Cost Category	Nearshore	Upland	Capping	Overdredging Confined Aquatic Disposal
Siting and Construction				
Core sampling for remedial design	x	x	x	x
Chemical analysis for remedial design	x	x	x	x
Design/permitting	x	x	x	x
Equipment modifications	x	x		x
Site acquisition	x	x		
Site preparation (dikes, weirs)	x	x		
Site liner	x	x		
Operation				
Equipment mobilization	x	x	x	x
Contaminated sediment dredging	x	x		x
Marine transportation of contaminated sediment	x	x		
Overland transportation of contaminated sediment		x		
Barge unloading to disposal site	x			x
Barge unloading to trucks		x		
Confined aquatic disposal site dredging				x
Disposal costs and fees	x	x		x
Capping of upland/disposal site	x	x		
Clean sediment dredging for contaminated site cap	x	x	x	
Clean sediment transportation for contaminated site cap	x	x	x	
Post Closure				
Confirmation sampling	x	x		
Confirmation analysis	x	x		
Well construction	x	x		
Monitoring sampling of disposal site	x	x	x	x
Monitoring sample analysis	x	x	x	x
Administration	x	x	x	x
Contingency	x	x	x	x

SITE PREPARATION

Site preparation costs were assessed only for the upland disposal alternative. These were estimated by using values from Table 5-4 of U.S. Army COE (1985), and applying an annual inflation rate of 5 percent to adjust the 1984 costs to 1989 dollars. The resulting value is $1.30/cubic yard of site capacity. Cost estimates were based on the assumption that all material from the problem area could be disposed of in the upland site, thus this cost is computed as $1.30/cubic yard of contaminated sediment after swelling and compaction.

SITE LINER

Liner costs also were assessed only for the upland disposal option. The liner is presumed to be 3 feet of clay over the entire area of the disposal site. The unit cost is based on Table 5-6 of U.S. Army COE (1985), and inflated from 1982 to 1989 dollars at a rate of 5 percent per year, yielding a value of $22.92/cubic yard of liner. Total cost is computed as the product of site area, liner depth, and the unit cost.

Use of other liner material, inclusion of a membrane, construction of a drainage system, and other modifications of this simple scenario may substantially affect the costs.

EQUIPMENT MOBILIZATION

The feasibility study lumps equipment mobilization with bonding and insurance, and calculates this as a fixed percentage of other costs. The approach used here is to assign a fixed cost to mobilization. The generic unit cost for a clamshell dredge used here is $150,000 per dredge (Parametrix 1989).

For remedial alternatives that include capping of the dredging site, total mobilization costs were based on the assumption that one dredge would be operating in the problem area and another at the source of clean sediment (e.g., the Puyallup River). The mobilization cost of the Puyallup River dredge was apportioned among the problem areas according to the fraction of total area to be capped in each.

CONTAMINATED SEDIMENT DREDGING

The unit cost of dredging may vary considerably, as described above, and as shown in the references. For this cost analysis a value of $3.00/cubic yard is used. This is based on a brief review of recent bids for dredging in Puget Sound (Sumeri, A., 1989, personal communication), which averaged approximately $2.50/cubic yard; and the costs estimated by Corlett and Kassebaum (1989), which ranged from $2.50/cubic yard to $12.00/cubic yard.

MARINE TRANSPORTATION OF CONTAMINATED SEDIMENT

Transportation of sediment by barge is estimated to cost about $0.30/cubic yard-mile, based on the figure of $0.25/cubic yard-mile cited in U.S. Army COE (1985), and adjusted for inflation. This is comparable to the cost of $0.25/cubic yard-mile cited in PSDDA (1988). Transportation costs were based on the volume of sediment after swelling.

OVERLAND TRANSPORTATION OF CONTAMINATED SEDIMENT

Overland transportation of contaminated sediment is estimated to cost \$0.50/cubic yard-mile, based on the marine transportation cost and the suggestion that trucking costs will exceed barging costs by about \$0.20/cubic yard-mile (U.S. Army COE 1985). Transportation costs were based on the volume of sediment after swelling.

BARGE UNLOADING TO DISPOSAL SITE

A unit cost of \$1.25/cubic yard that was used in the feasibility study is used for this cost analysis. Unloading costs were based on the volume of the sediment after swelling.

BARGE UNLOADING TO TRUCKS

A unit cost of \$2.50/cubic yard is used, based on an estimated cost of \$500,000 for 200,000 cubic yards of sediment (Parametrix 1989). Note that PSDDA (1988) has used a cost of \$1.50/cubic yard.

CONFINED AQUATIC DISPOSAL SITE DREDGING

The cost of confined aquatic disposal site dredging is presumed to be equivalent to that for dredging of contaminated sediment (i.e., \$3.00/cubic yard). Because of the overdredging approach, however, the sediment removed to create the confined aquatic disposal site will be deeper than the contaminated material. This additional depth may increase the unit cost. For example, Corlett and Kassebaum (1989) estimate that at the head of City Waterway problem area, removal of the first five feet of sediment will cost \$2.50/cubic yard, but removal of the underlying three feet will cost \$8.00/cubic yard.

The volume of material to be dredged for the confined aquatic disposal site is computed as the swollen and compacted contaminated volume plus the capping depth times the contaminated area. No estimation was attempted of the excess volume that would have to be dredged due to slumping of the excavation.

DISPOSAL COSTS AND FEES

The fee of \$0.40/cubic yard proposed by the Washington Department of Natural Resources (Corlett and Kassebaum 1989) for disposal at PSDDA Phase I disposal sites is used here. It is applied only to the excess volume of clean sediment removed from the confined aquatic disposal site. This sediment is presumed to meet PSDDA guidelines for open-water disposal.

CAPPING OF UPLAND/NEARSHORE DISPOSAL SITE

The unit cost used is based on a cap of 3 feet of sand and 3 feet of topsoil. In-place costs for these materials are taken from Table 5-6 of U.S. Army COE (1985), and inflated from 1982 to 1989 costs at a rate of 5 percent per year. The resulting average unit cost is \$23.84/cubic yard of capping material. The total volume of capping material is computed by multiplying the upland site area times the depth of cap (2 yards). A similar approach could be taken to estimating capping costs for a nearshore disposal site.

This generic cap may not be suitable for all sites; some may require a greater depth of material, different material (synthetic fabric, asphalt, concrete, or clay), revegetation, or other special measures taken for drainage or erosion control.

CLEAN SEDIMENT DREDGING FOR CONTAMINATED SITE CAP

Dredging of clean sediment is presumed to have a cost equivalent to that of contaminated sediment dredging ($3.00/cubic yard).

CLEAN SEDIMENT TRANSPORTATION FOR CONTAMINATED SITE CAP

Transportation of clean sediment is presumed to have a cost equivalent to that of marine transportation of contaminated sediment ($0.30/cubic yard-mile.).

CONFIRMATION SAMPLING

Confirmation sampling following removal of dredged material is presumed to be carried out by the collection of a grab sample of the sediment surface rather than a core, following the suggestion of the Commencement Bay Group (ENSR 1989). The cost of sample collection is estimated to be $500 per grab, producing one sample per grab. The number of samples is estimated as in the feasibility study: two samples per acre, with a maximum of 20 samples at a site.

CONFIRMATION ANALYSIS

Samples taken to confirm the success of remedial dredging are presumed to be analyzed for the same contaminants as the samples used to characterize the problem areas. Thus, the analysis cost varies with the problem area as specified in the feasibility study.

WELL CONSTRUCTION

The costs of establishing groundwater monitoring wells at upland and nearshore sites are based on drilling costs of $22.00 per foot, $600 for a screen (Deremer, R., 1989, personal communication), and an estimated $800 for a pump and equipment deployment. These unit costs were applied to an estimated 20 wells (the maximum number of sediment monitoring stations suggested by the feasibility study) of an average depth of 35 feet (the depth of fill possible at Blair Waterway Slip 1).

MONITORING SAMPLING OF DISPOSAL SITE

Sampling of confined aquatic disposal and capping sites is presumed to take place by coring, as specified in the feasibility study, with a cost of $1,500 per core. Frequency of sampling is two cores per acre, with a maximum of 20 cores. Sampling is presumed to be conducted yearly, and three samples analyzed from each core.

Sampling of groundwater monitoring wells is estimated to cost $120 per well, based on two hours of labor at $30 per hour (including sampling by a safety-certified specialist, document control, quality assurance, data management, and reporting), $30 of other direct costs per well, and a multiplier of 1.5. Frequency of sampling is presumed to be equivalent to that for coring at confined aquatic disposal and capping sites.

MONITORING SAMPLE ANALYSIS

Analysis costs for monitoring samples are presumed to be site-specific, as was assumed for the analysis costs for remedial design sampling and confirmation sampling. The site-specific costs used are those listed in the feasibility study.

ADMINISTRATION

Administration costs calculated in the feasibility study were as a percentage of all other costs. A similar approach was taken for the spreadsheet cost analysis. The feasibility study estimate included engineering costs, however, which were included in the design and permitting classification in the revised cost analysis. The factor for administration cost was therefore revised downward from the feasibility study value of 15 percent to 8 percent. The *EPA Remedial Action Costing Procedures Manual* (U.S. EPA 1985) suggests a range of 7-15 percent of capital costs for administration, including design and monitoring. The typical cost suggested by the *Multiuser Confined Disposal Sites Program Study* (Gershman, Brickner, and Bratton 1989) is 6 percent.

CONTINGENCY

A contingency cost of 20 percent of all other costs was applied. This is the same proportion used for the feasibility study.

OTHER FACTORS

Two factors were used to estimate the effect of sediment swelling and compaction. The swelling factor determines the increase in sediment volume after dredging and deposition in a barge; and the compaction factor determines the decrease in volume after confinement and compaction of the sediment. The swelling factor used for the revised cost estimate is 0.75, meaning that sediment would increase in volume by 75 percent upon dredging (Church 1981). As noted previously, this factor may be highly variable, so a value at the upper range of reported swelling factors was chosen. The compaction factor was chosen so that the net volume change from the original sediment in place would be an increase of 20 percent; the value of this factor is therefore selected to be 0.69 (i.e., 1.20/1.75).

The discount rate used for this revised cost calculation is 7 percent, which is a slightly lower estimated rate than the current rate of return on 2-year Certificates of Deposit.

The production rate for dredging was presumed to be 200 cubic yards/hour, as shown in Table 5-2 of U.S. Army COE (1985) for a 5-cubic yard clamshell dredge.

A dredging lift depth of four feet, typical of clamshell dredges (PSDDA 1988) is used for this calculation. The actual volume dredged is calculated based on the number of dredging lifts that would completely remove the contaminated sediment. Thus, contamination to a depth of 2 feet would require one dredging lift (with overdredging of 100 percent), whereas contamination to a depth of 5 feet would require two dredging lifts (with overdredging of 60 percent).

EXPLANATION OF SIGNIFICANT DIFFERENCES
COMMENCEMENT BAY NEARSHORE/TIDEFLATS SUPERFUND SITE

I. INTRODUCTION

Site Name and Location

Commencement Bay Nearshore/Tideflats Superfund Site
Tacoma, Pierce County, Washington
Operable Unit 01 - Sediments; and Operable Unit 05 - Sources

Lead and Support Agencies

U.S. Environmental Protection Agency (EPA) - Lead Agency for Sediment Remediation
Washington State Department of Ecology (Ecology) - Lead Agency for Source Control; Support Agency for Sediment Remediation
Puyallup Tribe of Indians - Support Agency

Statutory Authority

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 117(c) and National Oil and Hazardous Substances Contingency Plan (NCP), Section 300.435(c)(2)(I).

Purpose

The purpose of this Explanation of Significant Differences (ESD) is to modify the cleanup level for remediation of marine sediments contaminated with polychlorinated biphenyls (PCBs) at the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund site. EPA's September 30, 1989, Record of Decision (ROD) for the CB/NT Site established cleanup levels, called Sediment Quality Objectives (SQOs), for several problem chemicals found to be causing adverse effects to human health and the environment at the CB/NT Site. The SQO for PCBs was set at 150 μg/kg (micrograms per kilogram or parts per billion) dry weight (DW). The ROD required that the SQOs be met within ten years after completion of sediment remedial action. The ROD predicted that, if sediments with PCB concentrations greater than a Sediment Remedial Action Level (SRAL) of 240 - 300 μg/kg PCBs were removed, the 150 μg/kg PCB SQO would be met in 10 years through natural recovery processes. With this ESD, EPA is modifying the PCB SRAL to 450 μg/kg, to be achieved during cleanup, and the PCB SQO to 300 μg/kg, to be achieved within 10 years after cleanup.

EPA believes it is appropriate in some circumstances to make changes to existing decisions at Superfund sites to enhance overall remedy effectiveness and cost-effectiveness, as long as it does not compromise protectiveness or other objectives of the Superfund program. In this case, EPA decided to re-evaluate the PCB cleanup level for the CB/NT Site for the following reasons. 9/15/94

During pre-design sampling, new data were collected from the Hylebos Waterway showing that approximately twice the amount of sediment originally estimated in the ROD would require cleanup, and that cleanup costs would also be about twice the estimate in the ROD. In addition, EPA has updated the toxicity information it uses to assess human cancer risks associated with PCBs.

EPA's reevaluation of the PCB SQO at the CB/NT Site is described in a document entitled "Reevaluation of Residual Risks Associated with a Range of Sediment PCB Cleanup Levels in the Hylebos Waterway, Thea Foss Waterway, and Overall CB/NT Superfund Site" (Weston, 1997a) and in EPA's public review draft ESD (EPA, 1997). Based on EPA's reevaluation of the human health and environmental risks associated with PCBs, and through our evaluation using EPA's nine Superfund remedy selection criteria, EPA has determined that it is appropriate to modify the PCB cleanup level to 450 μg/kg, to be achieved during cleanup, and 300 μg/kg, to be achieved within 10 years after cleanup through natural recovery processes.

Cleanup to 450 μg/kg is expected to result in a post-cleanup average PCB concentration of less than 150 μg/kg in all waterways at the CB/NT Site. EPA estimates that the post-cleanup average PCB sediment concentration after cleanup to 450 μg/kg will be 75 μg/kg for the CB/NT Site, 124 μg/kg for the Hylebos Waterway, and 108 μg/kg for the Thea Foss Waterway. PCB sediment concentrations are expected to be further reduced over time due to natural recovery processes to approximately 63 μg/kg for the CB/NT Site, 80 μg/kg for the Hylebos Waterway, and 81 μg/kg for the Thea Foss Waterway.

Administrative Record

This ESD and other documents that EPA relied upon to make this decision are part of the Administrative Record for the CB/NT Superfund site, which is available to the public at the following locations:

U.S. Environmental Protection Agency
1200 6th Avenue, Records Center (7th floor)
Seattle, Washington 98101

Tacoma Public Library
Northwest Room
1102 Tacoma Avenue
Tacoma, Washington 98402

II. BACKGROUND

CB/NT ROD

The CB/NT Superfund site is located in Tacoma, Washington at the southern end of the main basin of Puget Sound. The site includes 10-12 square miles of shallow water, shoreline, and adjacent land, most of which is highly developed and industrialized. The upland boundaries of the site are defined according to the contours of localized drainage basins that flow into the marine waters. The marine boundary of the site is limited to the shoreline, intertidal areas, bottom sediments, and water of depths less than 60 feet below mean lower low water level. The nearshore portion of the site is defined as the area along the Ruston shoreline from the mouth of Thea Foss Waterway to Pt. Defiance. The tideflats portion of the site includes the Hylebos, Blair, Sitcum, Milwaukee, St. Paul, Middle, Wheeler-Osgood, and Thea Foss Waterways; the Puyallup River upstream to the Interstate-5 bridge; and the adjacent land areas (EPA, 1989). (Although the Blair and St. Paul Waterways have been deleted from the CB/NT Site because cleanups in those waterways are complete, they were included in the human health and ecological risk reevaluation of the PCB cleanup level.)

The Commencement Bay site has been divided into smaller project activities, called operable units (OU), in order to more effectively manage the overall cleanup of the site. In a September 30, 1989 ROD, EPA designated two operable units for the cleanup of the nearshore/tideflats portion of Commencement Bay: source control (OU 5), which focuses on efforts to control upland discharges or releases to the Bay, and sediment remediation (OU 1), which addresses the cleanup of the contaminated marine sediments in Commencement Bay. The Washington Department of Ecology (Ecology) is the lead agency for source control and EPA is the lead agency for sediment remediation.

EPA placed the CB/NT Site on the National Priorities List (NPL) of sites requiring investigation and cleanup under EPA's Superfund Program on September 8, 1983. A remedial investigation/feasibility study (RI/FS) was completed by Ecology in 1988. The RI/FS concluded that sediments in the nearshore/tideflats area were contaminated with a large number of hazardous substances at concentrations greatly exceeding those found in Puget Sound reference areas. In the RI, a multi-step decision-making process was used to identify problem chemicals, and to identify and prioritize problem areas where these chemicals were present at concentrations which are harmful to humans and wildlife. Over 50 problem chemicals and nine high priority problem areas were identified by this process.

In the 1989 ROD, EPA selected a remedial action for eight of the nine sediment problem areas. These problem areas are: 1) Mouth of Hylebos Waterway, 2) Head of Hylebos Waterway, 3) Sitcum Waterway, 4) St. Paul Waterway, 5) Middle Waterway, 6) Head of Thea Foss (formerly City) Waterway, 7) Mouth of Thea Foss Waterway, and 8) Wheeler-Osgood Waterway. The ninth problem area off-shore of the Asarco smelter will be addressed in a separate ROD.

PCBs, along with a number of other chemicals, were identified as problem chemicals in the Mouth and Head of Hylebos Waterway problem areas. PCBs have been detected at concentrations as high as 24,000 μg/kg in the Hylebos Waterway. PCBs are also present in the Thea Foss Waterway problem areas, however, current information indicates that cleanup of other chemicals such as polynuclear aromatic hydrocarbons (PAHs) and metals will also encompass

PCB-contaminated areas. PCBs are not widely distributed in elevated concentrations in other CB/NT problem areas.

The 1989 ROD describes a sediment remediation process which includes a combination of natural recovery and active sediment cleanup. For those areas in which modeling indicates that SQOs will not be achieved through natural recovery processes within ten years after sediment remediation, the ROD provides for confining and isolating the contaminated sediments by using one of four disposal options: in-place capping, dredging and confined aquatic disposal, dredging and nearshore disposal, or dredging and upland disposal. Natural recovery is the process whereby sediment concentrations in the upper sediment layers are reduced over time after source control and cleanup of highly contaminated sediments through mixing with and burial by more recently deposited clean sediments, as well as other natural processes such as biodegredation and diffusive loss to the water column. Other components of the selected remedial action for the eight CB/NT problem areas are: source control, site use restrictions, and long-term monitoring.

1989 ROD Cleanup Goals

The cleanup goal for the Commencement Bay problem areas is reduction of contaminant concentrations in sediments to levels that will support a healthy marine environment and will protect the health of people eating seafood from the Bay. The ROD designated biological test requirements and associated sediment chemical concentrations referred to as Sediment Quality Objectives (SQOs) in order to achieve this goal. The goal is established to allow a diverse range of uses in the bay including industrial, commercial, navigation, fisheries, and recreation.

SQOs for all problem chemicals were set based on an evaluation of the ecological and human health risks posed by these chemicals. The SQO for PCBs was based on the human health risk assessment. SQOs for all other chemicals were based on the ecological risk assessment, because the ecologically-based cleanup levels were determined to be also protective of human health.

<u>Ecological Risk-Based Cleanup Goals</u>

The chemical SQOs for protection of aquatic life were set using the Apparent Effects Threshold (AET) method. An AET is the sediment concentration of a chemical above which statistically significant biological effects are always observed in the test organism used to generate AET values. In other words, if any chemical exceeds its AET value for a particular biological indicator, then an adverse biological effect is predicted for that indicator. The three biological effects used to define the AET-derived SQOs were benthic infauna abundance, amphipod mortality, and oyster larvae abnormality. This method has subsequently been used, with some modifications, to develop the State of Washington's Sediment Management Standards (SMS - Chapter 173-204 WAC). The AET method predicted that a sediment PCB concentration of 1,000 μg/kg (dry weight) would be protective of aquatic life for the species tested. The AET method does not address bioaccumulation, and thus may underestimate risks to organisms who eat invertebrates or fish contaminated with bioaccumulative compounds like PCBs. It was determined that the SQO for PCBs should be set based on the risks to human health from eating PCB-contaminated seafood, because a lower PCB cleanup level was necessary to protect human health.

Human Health-Based Cleanup Goals

Human health risks from consumption of contaminated seafood at the CB/NT Site were evaluated in the 1988 RI/FS using chemical analysis of English sole (a bottom-dwelling flatfish) muscle tissue, English sole livers, and crab muscle tissue. Of the more than 100 chemicals analyzed, only PCBs were measured in seafood at concentrations significantly greater than background and sufficiently high to pose a potential threat to human health due to fish consumption. The risk assessment estimated a lifetime excess cancer risk of 6×10^{-3}, or 6 in 1,000, assuming that one pound of Commencement Bay fish are consumed each day. This means that, at most, a person has a 6 in 1,000 chance of getting cancer over his or her lifetime from eating one pound per day of fish with the PCB contaminant levels measured in Commencement Bay. A lifetime excess cancer risk of 2×10^{-4}, or 2 in 10,000, was estimated for a person eating one pound of Commencement Bay fish per month. The analysis focused on cancer risks as the most conservative estimate of risks to human health. The risk assessment estimated cancer risks only, because a PCB cleanup level based on cancer risks was shown to be protective of non-cancer related health risks as well.

These risks were estimated based on measured concentrations of total PCBs in fish. Maximum PCB concentrations in English sole muscle tissue were found in the Hylebos Waterway at 1,300 μg/kg (wet weight). English sole from the Hylebos Waterway had an average PCB concentration of 332 μg/kg, approximately ten times higher than the average concentration found in fish from the reference area at Carr Inlet (36 μg/kg). The CB/NT Site-wide average PCB concentration in English sole muscle tissue was 210 μg/kg.

Based on the human health risk assessment, a sediment SQO of 150 μg/kg (dry weight) total PCBs was set using the following method:

- An equilibrium partitioning approach was used to estimate that the PCB fish muscle tissue concentration of 36 μg/kg (wet weight) found in the Carr Inlet reference area would be associated with a sediment concentration of 30 μg/kg (dry weight) PCBs. A post-cleanup geometric mean sediment concentration of 30 μg/kg PCBs was set as a goal for the CB/NT Site.

- The overall post-cleanup sediment concentration was calculated based on the geometric mean of the post-cleanup data set assuming that PCB concentrations would be reduced to 20 μg/kg in all areas where PCB-contaminated sediments were remediated. It was determined that cleanup of areas with sediment PCB concentrations greater than 150 μg/kg would achieve an average post-cleanup residual PCB concentration of 30 μg/kg in sediments.

By this method, EPA calculated that a PCB SQO of 150 μg/kg would result in attainment of PCB concentrations in fish tissue similar to those in Puget Sound reference areas (36 μg/kg). The lifetime excess cancer risk associated with consumption of 12.3 grams of fish per day (approximately one pound per month) at the reference PCB concentration of 36 μg/kg was estimated to be 4 x 10^{-5}. EPA's goal for Superfund cleanups is to reduce human health risks to within a range of 10^{-4} to 10^{-6} (or 1 in 10,000 to 1 in 1,000,000).

III. DESCRIPTION OF AND BASIS FOR THE SIGNIFICANT DIFFERENCES

EPA started its reevaluation of the PCB SQO in 1996, by calculating the human health risks associated with PCBs remaining in sediments after cleanup to potential sediment cleanup levels ranging from 50 μg/kg to 900 μg/kg PCBs. That analysis used the risk assessment assumptions and equation used in the 1989 ROD, and updated it with current sediment quality data (Weston, 1996). This report was sent to several parties for review, and EPA received 20 comment letters. Many of the commentors asked EPA to update the risk assessment using current methods and assumptions. Several commentors also asked EPA to address ecological risks in its updated risk evaluation. The National Oceanic and Atmospheric Administration (NOAA) and the U. S. Fish and Wildlife Service (FWS) provided information on recent studies showing effects of PCBs on wildlife, as well as site-specific studies in the Hylebos Waterway. Based on these comments, EPA updated the ecological and human health risk evaluations (Weston 1997a), as discussed below.

In its analysis, EPA evaluated human health and ecological risks remaining immediately after cleanup, and in ten years after cleanup. EPA compared potential PCB cleanup levels to the PCB SRAL in the 1989 ROD of approximately 300 μg/kg. Reduction in risk over time due to natural recovery is also discussed. Because PCBs remain in tissues for a long time after exposure, it is important that exposure to PCBs in sediments is reduced immediately after cleanup, as well as in the long term.

The area evaluated for both the human health and ecological risk evaluations is the marine portions of the CB/NT Site as it is defined in the 1989 ROD. This includes the seven waterways at the southeast corner of Commencement Bay, and the shoreline, intertidal areas, bottom sediments, and water of depths less than 60 feet below mean lower low water level. The area considered in the risk evaluations in shown in Figure 1. Because there are no known sources of PCB contamination in Commencement Bay outside of the CB/NT Site, exposure to PCBs by people who fish and marine organisms which utilize other areas of Commencement Bay will be lower than estimated here.

Ecological Risk Evaluation

Several reviewers to the revised human health evaluation pointed out that EPA should reevaluate the ecological effects associated with a variety of potential cleanup levels using new information developed since the ROD was signed. To address ecological concerns, EPA used information provided by NOAA, FWS, and other sources to evaluate potential threats to wildlife, including invertebrates, fish, and piscivorous (fish-eating) birds, at a range of PCB sediment cleanup levels. A summary of the analysis (Weston, 1997a) is provided below.

Invertebrates

The 1989 ROD indicated that a 1,000 μg/kg PCB sediment cleanup level would be protective of aquatic invertebrates based on the AET approach, using direct measurements of benthic community abundance in Commencement Bay and in other areas in Puget Sound. Ecology subsequently used the AET approach as part of its Sediment Management Standards (SMS) to set a total organic carbon-normalized minor adverse effects level of 65 mg PCBs/kg carbon based on benthic infauna abundance, equivalent to EPA's 1,000 μg/kg (dry weight or DW). Ecology also set a no adverse effects level for PCBs equivalent to 130 μg/kg (DW), based on the Microtox™ test. In addition, a variety of effects levels indices have been developed by other agencies based on compilations of nationally collected data, for example, NOAA's effects range-median (ER-M) of 180 μg/kg (DW) PCBs. These indices, for the most part, fall within the range set by Ecology's no adverse effects and minor adverse effects levels (130 to 1,000 μg/kg PCBs).

Fishes

In 1994 and 1995, the NOAA National Marine Fisheries Service conducted a series of investigations on behalf of Commencement Bay Natural Resource Trustees to determine contaminant exposure and associated injuries to Hylebos Waterway fish. NOAA measured juvenile salmonid and adult English sole exposure to toxic chemicals in Hylebos Waterway sediments, and potentially associated effects on English sole, including impaired growth, mortality, reduced disease resistance, and reproductive dysfunction.

These studies found that juvenile salmon have been exposed to a wide variety of contaminants, including PCBs, as compared to fish from hatcheries or reference areas. The levels of PCBs in juvenile salmonids from the Hylebos Waterway were found to be similar to levels shown in previous studies to be associated with injuries (e.g., reduced growth, increased mortality).

English sole within Hylebos Waterway were also found to be exposed to PCBs and other compounds and exhibited both liver lesions and reproductive dysfunction. There has been little change over the last 10 years in indicators of fish health, such as liver lesions. NOAA's studies showed precocious sexual maturation in adult females and inhibited gonadal development in adult males. Increased incidence of early onset of sexual maturation appears to be most closely associated with exposure to PCBs. The NOAA studies have not identified an effects threshold concentration in either fish tissue or sediment which could be used to set a protective PCB cleanup level.

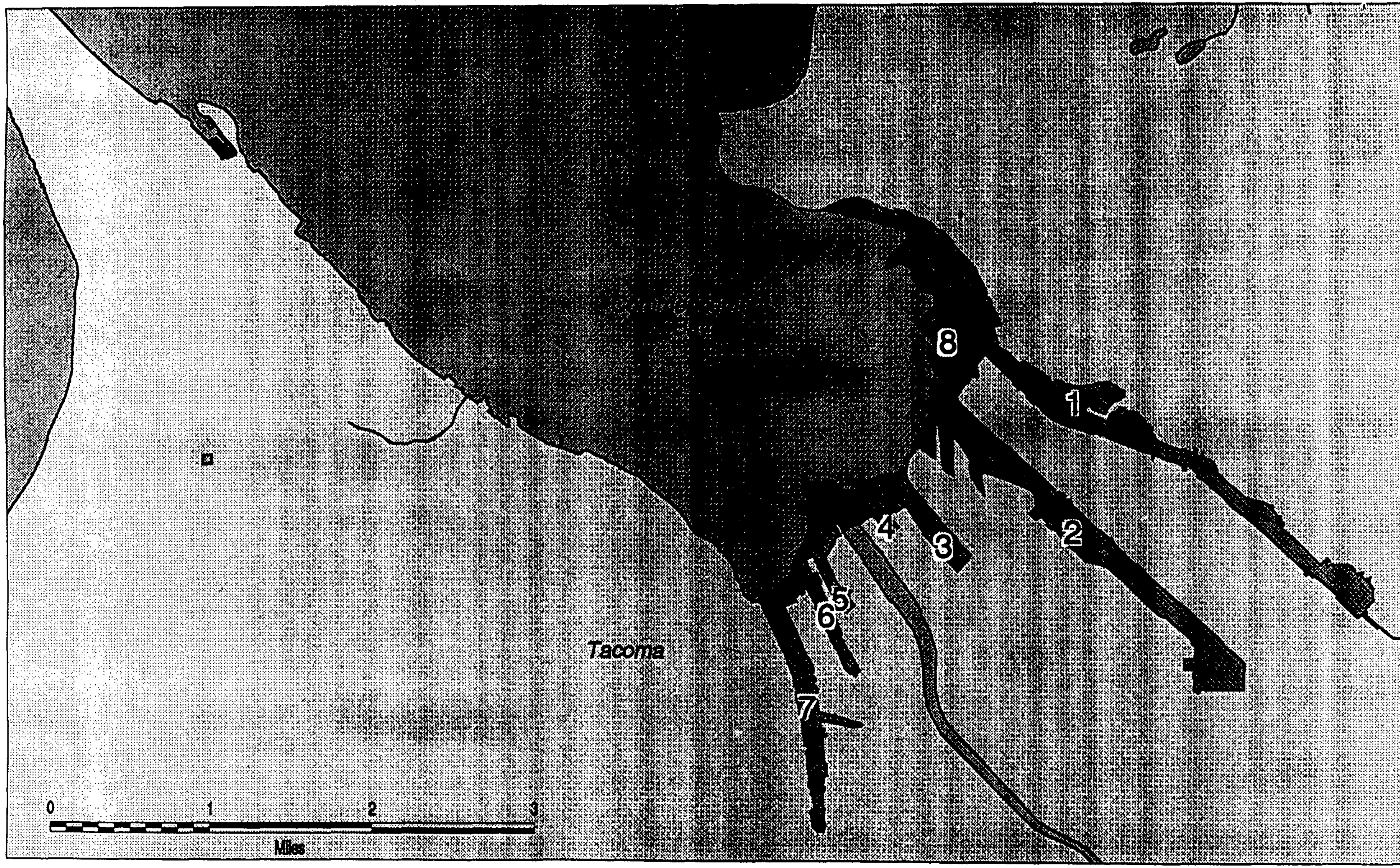

Figure 1

Commencement Bay

Areas Considered in Human Health and Ecological Risk Evaluation

Waterways:

1 Hylebos Waterway
2 Blair Waterway
3 Sitcum Waterway
4 Milwaukee Waterway
5 St. Paul Waterway
6 Middle Waterway
7 Thea Foss/Wheeler-Osgood
8 Nearshore Area

EPA

EPA calculated a no adverse effects level for salmon based on information showing that in the Duwamish River, hatchery salmon had statistically significantly lower growth, higher mortality, and lower body burdens of PCBs (about 137 μg/kg) than fish exposed to sediments and prey within the river. A protective sediment concentration can be calculated for Commencement Bay to be about 83 μg/kg PCBs as a sediment concentration that would not result in adverse effects to juvenile salmonids.

Because fish and birds obtain their prey from more than one location, it is appropriate to compare effects levels to average sediment concentrations that will be achieved as a result of cleanup, rather than the cleanup levels themselves. By dividing the estimated effects level by the post-cleanup average PCB concentration (as shown on Table A-1), a hazard quotient (HQ) can be calculated. An HQ which is less than 1 indicates a low potential for adverse effects. The estimated HQ for Commencement Bay and the individual waterways is shown in Table 1. As shown in Table 1, at the 300 μg/kg PCB SQO, the HQs for juvenile salmonids at the CB/NT Site, and the Hylebos and Thea Foss Waterways are all less than 1. At the 450 μg/kg PCB SRAL, the estimated HQ for juvenile salmonids are less than or equal to 1 for the CB/NT Site and the Hylebos and Thea Foss Waterways.

Table 1. Hazard Quotients for juvenile salmonids based on the 150 μg/kg SQO in the 1989 ROD and the revised PCB SQO of 300 μg/kg and SRAL of 450 μg/kg.

Organism	Cleanup level (μg/kg)	Hazard Quotient		
		CB/NT Site	Hylebos Waterway	Thea Foss Waterway
Juvenile Salmonids	150	< 1	< 1	< 1
	300	< 1	< 1	< 1
	450	< 1	1	< 1

Note: HQ for the CB/NT Site assumes fish obtain 100% of their diet from the CB/NT Site. HQ for the individual waterways assume fish obtain 100% of their diet from that waterway.

Birds

For its analysis of potential effects of PCB-contaminated sediments on birds, EPA drew upon a FWS assessment of the potential for injury based on calculation of a hazard quotient or ratio between the predicted egg concentration and an egg concentration reported in the literature to be associated with significant ecological impacts, such as embryonic deformity and egg lethality. The amount of sediment transfer from sediments to fish, from fish to birds and subsequently to bird eggs, was estimated using information from EPA and FWS studies on transfer of PCBs and dioxins between predators and prey.

Hazard quotients were calculated for shorebirds and piscivorous (fish eating) birds by dividing the estimated sediment concentrations above which adverse effects to bird eggs are predicted to occur under the assumptions in the risk assessment by the post-cleanup average sediment PCB concentration. These results are shown in Table 2. Table 2 shows HQs of less than or equal to 1 for shorebirds and piscivorous birds at the 300 μg/kg PCB SQO. At the 450 μg/kg PCB SRAL, HQs for shorebirds and piscivorous birds are at 2 or below.

Table 2. Hazard Quotients for shorebirds and piscivorous birds, based on the 150 μg/kg SQO in the 1989 ROD and the revised PCB SQO of 300 μg/kg and SRAL of 450 μg/kg.

Organism	Cleanup level (μg/kg)	Hazard Quotient		
		CB/NT Site	Hylebos Waterway	Thea Foss Waterway
Shorebirds	150	< 1	< 1	< 1
	300	< 1	< 1	< 1
	450	1	1	< 1
Piscivorous Birds	150	1	< 1	< 1
	300	1	1	< 1
	450	2	2	1

Note: HQ for the CB/NT Site assumes birds obtain 100% of their diet from the CB/NT Site. HQ for the individual waterways assume birds obtain 100% of their diet from that waterway.

<u>Uncertainties</u>

The estimates of potential risk to invertebrates, fish, and birds incorporate a number of assumptions, all of which have uncertainties associated with them. Examples of uncertainties and their effect on the resulting risk estimates are discussed below.

Although the AET database used to estimate risks to invertebrates was developed using Commencement Bay data, along with data from other areas in Puget Sound, recent biological data collected for the Hylebos Waterway indicate that the AET database may have overestimated the chemical concentration at which impacts were expected to occur.

For birds, the biomagnification factor (an estimate of contaminant transfer between predators and prey) was developed based on empirical data on alewives and herring gull in the Great Lakes. The accuracy of this estimate when applied to other species, especially species higher on the food chain, is uncertain.

The calculation of a protective sediment concentration for juvenile salmonids is uncertain because of the extrapolation of Duwamish estuary data to Commencement Bay and application of a biota-sediment accumulation factor (an estimate of the transfer of contaminants from sediments to organisms) developed for bottom fish to a water column species. Use of these data and associated assumptions may either over- or underestimate risks to juvenile salmonids, and should not be extrapolated to other types of fish.

The estimated HQs for fish and birds assume that they obtain all of their food from within the CB/NT Site. The actual foraging habits and foraging range of fish and birds varies by species and in many cases, by season. The assumption used in the ecological risk evaluation will overestimate the exposure of species or individuals with large foraging ranges (such as migratory birds) but the CB/NT Site-wide risk estimate may underestimate the exposure of resident species that preferentially feed at a specific location.

Summary of Ecological Risk Evaluation

In summary, the updated ecological risk analysis showed that the 300 μg/kg PCB SQO and 450 μg/kg PCB SRAL is protective of the benthic community, juvenile salmonids, shorebirds and piscivorous birds. Cleanup to the 300 μg/kg PCB SQO will reduce all HQs estimated for these species to 1 or below.

Human Health Risk Evaluation

Exposure Assumptions

EPA updated the human health risk evaluation and used it as a basis to evaluate the risks associated with a variety of potential PCB cleanup levels in a February 1997 report (Weston, 1997a). Although EPA's risk assessment methodology has not been modified substantially since the original risk assessment was performed in 1988, some of the exposure and toxicity assumptions have been changed based on new information and new Superfund guidance.

As with the 1989 ROD, the updated risk evaluation focused on risks due to consumption of PCB-contaminated seafood. The National Contingency Plan (40 CFR Part 300) calls for EPA to use a reasonable maximum exposure (or "high-end") scenario for making Superfund cleanup decisions. EPA also recommends calculating an average exposure scenario for comparison purposes. Four scenarios were used in the updated risk evaluation: average recreational fishing, "high-end" recreational fishing, average tribal fishing, and "high-end" tribal fishing.

Because the Puyallup Tribe of Indians has treaty rights to fish in Commencement Bay, high-end tribal fishing was used as the reasonable maximum exposure scenario for EPA's decision-making purposes. An average and high-end recreational fishing scenario and an average tribal fishing scenario were also calculated for purposes of comparison. Fish consumption rates for the recreational fishing scenario are the same as used in the 1989 ROD. Because no studies have documented tribal fish consumption rates in Commencement Bay, they were estimated from recently completed surveys of fish consumption by members of two other Puget Sound Indian tribes, the Tulalip and Squaxin Island Tribes (Toy et al., 1996). The high-end tribal scenario represents risks to a tribal fisherperson who consumes a relatively large amount (upper 90th percentile) of fish compared to other tribal members.

A summary of the fish ingestion rates assumed for each of the four scenarios used in the updated residual risk evaluation and the scenario used in the ROD risk evaluation is presented in Table 3. Information about all of the assumptions used in the risk assessment, and modifications made to update the original risk assessment, is provided in Weston (1997a) and Appendix A.

Table 3: Fish ingestion rates used in the updated residual risk evaluation, and in the CB/NT ROD.

Scenario	Fish Ingestion Rate (1)	Basis
High-end Tribal Fishing	123 g/day (approx. 20 meals/month)	Tulalip/Squaxin Island Fish Consumption Survey (Toy et al., 1996)
Average Tribal Fishing	41.7 g/day (approx. 7 meals/month)	Tulalip/Squaxin Island Fish Consumption Survey (Toy et al., 1996)
High-end Recreational Fishing	95.1 g/day (approx. 15 meals/month)	CB/NT ROD (1989)
Average Recreational Fishing	12.3 g/day (approx. 2 meals/month)	CB/NT ROD (1989)
CB/NT ROD	12.3 g/day (approx. 2 meals/month)	A combination four recreational fishing surveys, as summarized in Tetra Tech, 1988

(1) One half pound of fish per meal was used to calculate meals/month.

Cancer Risks

Post-cleanup residual cancer risks were calculated for a range of potential PCB sediment cleanup levels from 50 μg/kg to 900 μg/kg. Results for the high-end tribal fishing scenario at the former PCB SQO of 150 μg/kg and the current 300 μg/kg PCB SQO and 450 μg/kg SRAL are shown in Table 4. Cleanup to all of these cleanup levels will result in substantial risk reduction over current conditions. The residual human health cancer risks for the high-end recreational fishing scenario were similar to results for the high-end tribal fishing scenario, and results for the average recreational and average tribal fishing scenarios are three to ten times lower than for either of the high-end scenarios. For comparison, human health cancer risks from fish consumption at Puget Sound background conditions in non-industrial areas under the high-end tribal fishing scenario is 6×10^{-5} (Weston 1997c). Additional information about the results of the risk evaluation is presented in Appendix A.

Table 4. Post-cleanup residual cancer risk (using the high-end tribal fishing scenario) based on the 150 μg/kg PCB SQO in the 1989 ROD and the revised PCB SQO of 300 μg/kg and SRAL of 450 μg/kg.

PCB Cleanup level (μg/kg)	Estimated post-cleanup residual cancer risk under the high-end tribal fishing scenario		
	CB/NT Site	Hylebos Waterway	Thea Foss Waterway
Current Conditions (no cleanup)	9.8×10^{-4}	1.1×10^{-3}	1.7×10^{-4}
150	9.4×10^{-5}	4.9×10^{-5}	4.6×10^{-5}
300	1.2×10^{-4}	1.1×10^{-4}	7.6×10^{-5}
450	1.4×10^{-4}	1.6×10^{-4}	1.0×10^{-4}

As shown in Table 4, the estimated post-cleanup cancer risks at the 300 μg/kg PCB SQO are within EPA's acceptable risk range of 10^{-4} to 10^{-6}. Cleanup to the 450 μg/kg PCB SRAL will result in interim risks that are also within EPA's acceptable risk range. Although the estimated risk is 1.4×10^{-4} for the CB/NT Site and 1.6×10^{-4} for the Hylebos Waterway, EPA policy states that the upper boundary of the risk range is not a discrete line at 1×10^{-4}. Cleanups to levels slightly greater than 1×10^{-4} may be considered acceptable if justified based on site-specific conditions. People are more likely to fish in more than one location in Commencement Bay than in Hylebos Waterway alone, so the CB/NT Site-wide risk estimate is the best estimate of risks to area fisherpersons.

These cancer risk estimates are based on a number of assumptions, all of which have uncertainties associated with them. For example, although studies suggest that exposure to PCBs increases cancer risk in humans, EPA's cancer slope factor (an estimate of the potency of PCBs to cause cancer) is derived mainly from studies on laboratory animals. Similarly, estimates of the transfer of PCBs from sediments to fish and from fish to humans, the amount and type of fish consumed by individuals in the area, and many other factors make it difficult to estimate an individual's exposure to PCBs from eating fish from Commencement Bay. Although the risk numbers in Table 4 and Appendix A are estimates that have many uncertainties associated with them, they were derived in a manner to ensure they are protective of health and are unlikely to underestimate actual risks to fish consumers.

Non-cancer risks

In the human health risk assessment done for the CB/NT Site in 1985, the potential for both cancer and non-cancer health effects from exposures to PCBs in fish from the CB/NT Site was evaluated. Based on the information available on the toxicity of PCBs at that time, it was concluded that the potential for non-cancer impacts was not of concern. Therefore, when the

ROD was written in 1989, EPA based its cleanup level for PCBs on human health cancer risks from ingestion of PCB-contaminated fish caught in the Bay.

Similarly, in the updated risk evaluations (Weston 1996, 1997a) and in EPA's public review draft ESD (EPA, 1997), EPA focused on cancer risks associated with PCBs, and updated non-cancer risk information was not presented in these reports. In response to public comments, EPA has prepared a technical memorandum which provides information regarding non-cancer risks under current and post-cleanup conditions using the scenarios developed for the cancer risk evaluation. This technical memorandum (Weston, 1997b) has been added to the Administrative Record for our final decision. A summary is provided below.

Based upon an understanding of the development of non-cancer health effects, potential non-cancer impacts are evaluated by EPA assuming that there is a level of exposure below which health impacts are unlikely to occur. The estimate of this level of exposure is called the reference dose, or RfD, and is defined as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime." Exposures that are less than the RfD are not likely to be associated with adverse health impacts.

In order to calculate non-cancer risks for site-specific risk assessments, EPA compares the RfD to the exposures estimated for that site (e.g., from eating contaminated fish). This comparison, called the Hazard Quotient or HQ, is the ratio between the estimated site exposure and the RfD. As with cancer risk, the assumptions used in calculating the HQ are conservative ones (health protective) to ensure that remedial decisions based upon them will protect more sensitive individuals. Because of the way in which the HQ is derived, it should not, however, be viewed as a strict demarcation between toxic and nontoxic. HQ values above 1 do not mean that non-cancer health impacts will occur, but rather that the potential for such impacts increases as 1 is exceeded. The potential for impacts depends on a number of factors, including the protectiveness of both the RfD and the exposure assumptions used to calculate the HQ. The derivation of the RfD for PCBs is based upon a large body of experimental data and incorporates a several hundred fold uncertainty factor ("safety" factor) to ensure protection.

Results of this non-cancer risk evaluation are shown in Tables 5 and 6. Both the cleanup required under the 1989 ROD and in this ESD provide for substantial reduction in the non-cancer risks associated with PCBs in sediments at the CB/NT Site. As with cancer risks, the residual human health non-cancer risks for the high-end recreational fishing scenario were similar to results for the high-end tribal fishing scenario, and results for the average recreational and average tribal fishing scenarios are three to ten times lower than for either of the high-end scenarios. For comparison, the human health hazard quotient for non-cancer risks due to PCBs from fish consumption at Puget Sound background conditions in non-industrial areas under the "high-end" tribal fishing scenario is 3 (Weston, 1997c). As with cancer risks, given the range of uncertainty in risk calculations, these post-cleanup HQs are not significantly different. Also, the exposure assumptions used in the CB/NT risk evaluation were selected to be protective for a consumer of large amounts of fish from the CB/NT Site over a 30-year period. Given these conservative assumptions, the small increases above an HQ of 1 estimated for the various target cleanup levels and for background suggest a low potential for non-cancer impacts for the fish consumers considered in the calculations. Individuals who eat less fish from the CB/NT Site will have exposures and HQs that are lower and, therefore, their potential for non-cancer impacts will be less. Therefore, EPA does not believe that the 300 μg/kg PCB SQO provides significantly different non-cancer risks than the PCB cleanup level in the 1989 ROD.

Table 5. Post-cleanup residual non-cancer risk (using the high-end tribal fishing scenario) based on the 150 μg/kg PCB SQO in the 1989 ROD and the revised PCB SQO of 300 μg/kg and SRAL of 450 μg/kg.

PCB Cleanup level (μg/kg)	Estimated post-cleanup residual non-cancer risk under the high end tribal fishing scenario		
	CB/NT Site	Hylebos Waterway	Thea Foss Waterway
Current Conditions (no cleanup)	60	60	10
150	6	3	3
300	7	6	4
450	8	9	6

Table 6. Post-cleanup residual non-cancer risk (using the average tribal fishing scenario) based on the 150 μg/kg PCB SQO in the 1989 ROD and the revised PCB SQO of 300 μg/kg and SRAL of 450 μg/kg.

PCB Cleanup level (μg/kg)	Estimated post-cleanup residual non-cancer risk under the average tribal fishing scenario		
	CB/NT Site	Hylebos Waterway	Thea Foss Waterway
150	2	1	1
300	2	2	2
450	3	3	2

Summary of Significant Differences

Based on the information received and developed by EPA, this ESD modifies the PCB SQO for the CB/NT Site to 300 μg/kg, to be achieved within 10 years after remediation; and the PCB

SRAL to 450 μg/kg, to be achieved during cleanup. EPA used the nine remedy selection criteria contained in the NCP and listed below to evaluate and select the revised PCB cleanup level. Based on our analysis, EPA has determined that a PCB SQO of 300 μg/kg and SRAL of 450 μg/kg achieves the best balance of the nine evaluation criteria. Table 7 compares the PCB cleanup level in the 1989 ROD to the new cleanup levels.

Table 7. Comparison of post-cleanup maximum and average PCB concentration under the PCB cleanup level in 1989 ROD to the PCB cleanup level in this ESD.

	1989 ROD		1997 ESD	
	Immediately after cleanup (μg/kg)	Within 10 years after cleanup (μg/kg) (1)	Immediately after cleanup (μg/kg)	Within 10 years after cleanup (μg/kg)
CB/NT Site	300 max/63 avg	150 max/51 avg	450 max/75 avg	300 max/63 avg
Hylebos Waterway	300 max/80 avg	150 max/37 avg	450 max/124 avg	300 max/80 avg
Thea Foss Waterway	300 max/81 avg	150 max/49 avg	450 max/108 avg	300 max/81 avg

(1) The 1989 ROD calculated a 36 μg/kg post-cleanup geometric mean for the CB/NT Site at the 150 μg/kg SQO. The averages shown here are arithmetic means.

The 1989 ROD set numerical SQOs for a number of chemicals, to be achieved within 10 years after cleanup. SRALs, or the cleanup levels to be met at the time of cleanup, are estimated in the 1989 ROD, but were to be established based on natural recovery modeling efforts during the design phase. Based on the information developed and comments received during the reevaluation of the PCB cleanup level, EPA is establishing with this ESD the maximum SRAL as well as the SQO for the CB/NT Site. Even if natural recovery modeling shows that some areas with a higher PCB concentration will naturally recover to 300 μg/kg in 10 years, in accordance with this ESD, areas with PCB concentrations of 450 μg/kg or higher will still be remediated.

EPA is making this modification because it considers 450 μg/kg to be the highest concentration of PCBs which should be allowed in CB/NT Site sediments after cleanup. The 450 μg/kg PCB SRAL is at the high end of the range EPA considers to be protective of human health and the environment. Because PCBs remain in the body for several years after uptake, any short-term exposure in the 10 years to achieve the SQO could have long-term effects to those exposed during that period. Therefore, a 450 μg/kg minimum PCB cleanup level will be required under all circumstances at the time of cleanup. If natural recovery modeling shows that a cleanup level lower than 450 μg/kg is necessary in some areas to achieve the 300 μg/kg SQO in 10 years, a lower cleanup level will be implemented. Based on natural recovery modeling done to date, EPA anticipates that this might occur in only a few, if any, locations. This approach is consistent with the 1989 ROD, which states that natural recovery is expected to be effective in marginally contaminated portions of the problem areas, but is not intended to address severe levels of contamination.

In the public review draft ESD, EPA's proposal was to require that PCB-contaminated sediments be cleaned up to 450 μg/kg PCBs, with no further natural recovery requirements. EPA's final decision is to add a natural recovery component to achieve 300 μg/kg PCBs in sediments within 10 years after remedial action. EPA believes this change is appropriate for two reasons:

1) EPA's original proposal relied on estimates of additional natural recovery to ensure protectiveness. Setting a long-term SQO, however, ensures that natural recovery modeling and monitoring will occur to verify these reductions in PCB concentrations over time, and that additional cleanup work will be implemented to achieve 300 μg/kg PCBs if sediments do not naturally recover to this level within 10 years.

2) Although dredging to 300 μg/kg PCBs would be unreasonably costly for the relatively small risk reduction achieved, costs associated with natural recovery to 300 μg/kg are relatively small and do not outweigh the benefits of additional risk reduction.

Natural recovery models done for the 1989 ROD indicate that PCB concentrations should be reduced to less than 300 μg/kg within 10 years after cleanup to 450 μg/kg. The cost of long-term monitoring in the natural recovery areas is estimated at $310,000. The cost of additional modeling is negligible given that modeling work is already being done to predict natural recovery rates of other chemicals. Even if the models have not accurately predicted the rate of natural recovery, and additional cleanup is needed ten years after cleanup, it is anticipated that cost-effective methods can be used to remediate sediments with contaminant concentrations between 300 and 450 μg/kg PCBs.

<u>EPA's Nine Evaluation Criteria</u>

<u>Threshold Criteria</u>
- Overall protection of human health and the environment
- Compliance with applicable, or relevant and appropriate, regulations (ARARs)

<u>Primary Balancing Criteria</u>
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility and volume through treatment
- Short-term effectiveness
- Implementability
- Cost

<u>Modifying Criteria</u>
- State and Tribal acceptance
- Community acceptance

The 1989 ROD evaluated cleanup alternatives against the nine CERCLA evaluation criteria. In this section, these criteria are discussed only to the extent that they would be affected by the change in the PCB cleanup level. Because a modification to the PCB cleanup level will significantly affect only the Hylebos Waterway cleanup, the analyses of cost and implementability focus mainly on the Hylebos Waterway. In this analysis the 450 $\mu g/kg$ PCB SRAL is compared to the 1989 ROD SRAL of approximately 300 $\mu g/kg$, and the 300 $\mu g/kg$ PCB SQO is compared to the 150 $\mu g/kg$ PCB SQO in the 1989 ROD. Other potential cleanup levels are also discussed.

Overall Protection of Human Health and the Environment

The NCP states that for chemicals which are known to cause cancer, cleanup levels should be selected within a cancer risk range of 10^{-4} to 10^{-6} . Within that range, the NCP calls for EPA to select a cleanup goal which achieves the best balance of the remaining remedy selection criteria, with a preference for selecting cleanup goals that approach 10^{-6} where possible.

As shown in Table A-4, the human health risk evaluation for the CB/NT Site showed that all of the potential cleanup levels evaluated, from 50 $\mu g/kg$ PCBs to 900 $\mu g/kg$ PCBs, would result in post-cleanup residual cancer risks within EPA's risk range of 10^{-4} to 10^{-6}. Lower PCB cleanup levels provide more protectiveness, and calculated residual risks are closer to EPA's "point of departure" of 10^{-6}. Higher cleanup levels are at the less protective end of the range. As shown in Table A-4, there is very little difference in residual human health cancer risks between the ROD PCB SQO of 150 $\mu g/kg$ and the revised SQO of 300 $\mu g/kg$ set by this ESD. Both will result in human health cancer risks for the CB/NT Site of approximately 1×10^{-4}. As shown in Table 7, average sediment PCB concentrations after cleanup to the 450 $\mu g/kg$ SRAL will be reduced to well below 150 $\mu g/kg$ and will be further reduced over time to approximately 63 $\mu g/kg$ within 10 years after cleanup.

The NCP does not set a numeric target range for non-cancer risks, but states that acceptable exposure levels shall represent concentrations to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety. Cleanup to 300 $\mu g/kg$ PCBs will result in a CB/NT Site-wide HQ of 7. The HQ of 7 is not appreciably different than the HQ of 6 estimated for cleanup to 150 $\mu g/kg$ PCBs under the 1989 ROD. Although EPA generally attempts to achieve a HQ of 1 or below in Superfund cleanups, in this case the HQ is greater than 1 even under background conditions. Because of the conservative assumptions built into the risk assessment and into the reference dose used to calculate the HQ, EPA believes that cleanup to 300 $\mu g/kg$ PCBs is protective of non-cancer risks.

The ecological evaluation also shows that lower cleanup levels are associated with increased protection to wildlife. EPA's analysis estimates that a PCB SQO of 300 $\mu g/kg$ and SRAL of 450 $\mu g/kg$ will be protective of ecological receptors. Both values are below the 1,000 $\mu g/kg$ PCB AET calculated in the CB/NT ROD as being protective of benthic infauna. Both values also fall between Ecology's minor adverse effects level (equivalent to 1,000 $\mu g/kg$ dry weight) and no adverse effects level (equivalent to 130 $\mu g/kg$ dry weight) as promulgated under the State's

Sediment Management Standards to protect aquatic life. The updated ecological risk analysis for fish, shorebirds, and piscivorous birds estimates a HQ of less than or equal to 2 immediately after cleanup and less than or equal to 1 within 10 years after cleanup.

The risk evaluation shows that cleanup to EPA's revised SQO of 300 $\mu g/kg$ PCBs and SRAL of 450 $\mu g/kg$ PCBs will result in a substantial reduction in risk to human health and the environment due to PCBs at the CB/NT Site. They will reduce cancer risks to within EPA's acceptable risk range, and will be protective of non-cancer risks and wildlife.

Compliance with ARARs

There are no federal or state regulations that provide human-health based PCB cleanup levels for sediments. Since publication of the ROD, the State of Washington has promulgated Sediment Management Standards (SMS), which require that contaminant levels in sediments within the State be protective of human health and aquatic life. The SMS contains numeric chemical criteria for protection of aquatic life (Chapter 173-204 WAC). The SMS also requires that sediment cleanups be protective of human health, and states that Ecology will determine sediment criteria which are protective of human health on a case by case basis, but contains no numeric standards for human health protection.

The CB/NT ROD and the Washington State SMS share the same narrative goal of the absence of acute or chronic adverse effects on biological resources or significant human health risk. They also share the use of the AET process (as described in the 1989 ROD, with some modifications introduced into the State SMS) to select chemical sediment criteria for protection of aquatic life.

The NCP provides that a promulgated state environmental requirement is an ARAR if it is more stringent than cleanup levels developed by EPA as a result of the human health and ecological risk assessments. The NCP also states that state environmental standards promulgated after the signing of a ROD must be attained only if they are applicable, or relevant and appropriate, and necessary to ensure protectiveness. EPA evaluated the State SMS requirements for ecological and human health-based cleanup levels and determined that it was not more stringent than the evaluation process EPA used to select a PCB cleanup level, nor was application of the State SMS requirements necessary to ensure protectiveness.

Long-term Effectiveness and Permanence

Under this criterion, EPA evaluates the magnitude of residual risk after cleanup, and the adequacy and reliability of long-term controls. As discussed under the "protection of human health and the environment" section, cleanup to the 450 $\mu g/kg$ SRAL and natural recovery to the 300 $\mu g/kg$ SQO, rather than the 1989 ROD SRAL of 300 $\mu g/kg$ and SQO of 150 $\mu g/kg$, will result in a slightly higher residual risk after cleanup. CB/NT Site-wide estimated residual cancer risks due to PCBs for the 1989 SQO of 150 $\mu g/kg$ PCBs are 9.4×10^{-5} versus 1.2×10^{-4} for the 300 $\mu g/kg$ SQO under this ESD. For Hylebos Waterway, estimated residual cancer risks for the former 150 μg/kg PCB SQO are 4.9 x 10^{-5} versus 1.1 x 10^{-4} for the 300 μg/kg SQO under this ESD. Similarly, the non-cancer HQ for the CB/NT Site is 6 under the 1989 ROD SQO and 7 under the revised SQO.

Average post-cleanup PCB concentrations will be reduced to less than 150 μg/kg immediately after cleanup, and will be reduced further over time through natural recovery processes. As shown in Table 7, PCB concentrations will be reduced to a maximum of 300 μg/kg and an average of 63 μg/kg PCBs in 10 years.

For cleanup to the PCB cleanup levels in the 1989 ROD and this ESD, tested and reliable technologies exist for containing sediments and preventing contaminant migration in the long term. As discussed below, a greatly increased volume of PCB-contaminated sediments would require containment under the current ROD, as compared to the PCB cleanup required under this ESD. By reducing the volume of sediments that require confinement, a smaller disposal site (or fewer disposal sites) will be required. This will reduce the cost and complexity of long-term monitoring and engineering controls to ensure the protectiveness of confined disposal.

Reduction of toxicity, mobility and volume through treatment

This criterion is unaffected by the range of alternatives evaluated for a modified PCB sediment cleanup level because the cleanup plan for contaminated sediments under the 1989 ROD does not involve treatment.

Short-term effectiveness

The analysis of short-term effectiveness remains the same as presented in the original ROD, except to note that changing the SRAL from 300 to 450 μg/kg PCBs decreases the volume of sediments requiring remediation by approximately 400,000 cubic yards. This in turn decreases the short term disruption to aquatic organisms living in the sediments during remediation. Approximately twice as much of the surface area of the Hylebos Waterway would have been disrupted through dredging or capping at the 300 μg/kg PCB SRAL than at 450 μg/kg. For all cleanup volumes, a monitoring program will be implemented and measures will be taken to control releases of contaminated sediments to the water column.

Implementability

Cleanup of contaminated sediments under the PCB cleanup levels in the 1989 ROD and this ESD is technically feasible. However, due to the limited number and capacity of disposal sites in Commencement Bay, the larger the volume of sediments to be remediated, the greater the difficulty in selecting a suitable disposal site or sites. Also, at higher cleanup volumes, multiple disposal sites would be needed for the Hylebos Waterway cleanup, in addition to sites required for other waterway cleanups, which will increase the cost, as well as technical and administrative difficulties, associated with implementing the remedy. Because remediation to the 300 μg/kg

PCB SRAL under the 1989 ROD requires remediation of appproximately 400,000 cubic yards more sediments than remediation to the 450 μg/kg SRAL required under this ESD, EPA's current proposal is more technically and administratively feasible than cleanup to the former SRAL.

Cost

Because the volume of sediments requiring remediation in CB/NT problem areas other than the Hylebos Waterway is largely unaffected by the PCB cleanup level, the cost analysis presented here is focused on the Hylebos Waterway. The ROD estimated that 1,167,000 cy of Hylebos Waterway sediments are contaminated at concentrations exceeding the ROD SQOs. The ROD estimated that a cleanup of 447,000 cy of contaminated sediments would allow the Waterway to recover to meet SQOs for all chemical contaminants in 10 years. The ROD estimated a cost of $13,850,000 for cleanup of Hylebos Waterway sediments using confined aquatic disposal, and that costs would be higher for upland disposal and lower for other disposal options.

Table 8 shows the volume of sediments requiring remediation and estimated cleanup costs for the Hylebos Waterway, based on current information. As shown in Table 8, the estimated cost to achieve the 150 μg/kg PCB cleanup level in 10 years (assuming an SRAL of 300 μg/kg) has more than doubled since the ROD estimated $13 million.

Table 8. Estimated sediment cleanup volumes for the Hylebos Waterway and associated cost of remediation at a range of PCB cleanup levels.

PCB Sediment Remedial Action Level (μg/kg)	Cleanup Volume (PCB-contaminated sediments only) (cy)(1)	Cleanup Volume (cleanup of all contaminated sediments) (cy) (1)	Estimated Cleanup Cost (for all contaminated sediments) (millions) (2)
150	1,115,700	1,339,000	$46.5 (3)
300	559,721	891,000	$31(3)
450	246,565	508,000	$18
600	149,444	436,000	$15.5
750	107,206	409,000	$14.5
900	84,910	399,000	$14

(1) Estimated volume of PCB-contaminated sediments was calculated in Fuglevand (1996). Estimated volume of all contaminated sediments was estimated using Fuglevand (1996) and an estimate of 350,000 cy for cleanup of all contaminants other than PCBs, based on current unpublished estimates of the volume of sediment requiring cleanup to ecologically-based cleanup levels of approximately 300,000 to 400,000 cy.

(2) Estimated cost of cleanup was derived using a $35/cy estimate for nearshore fill from Hartman (1996). The estimated cost for confined aquatic disposal is approximately the same as for nearshore fill; upland

disposal would increase the cleanup cost by approximately 46%.
(3) For cleanup volumes of greater than 700,000 cubic yards, multiple disposal sites may be needed, so cleanup costs for these options may be underestimated.

Table 8 and Figure A-1 shows the volume of sediments requiring cleanup at the range of PCB cleanup levels considered. The cost of cleanup is directly related to the volume of contaminated sediments requiring cleanup, and the post-cleanup average PCB concentration gives an idea of the environmental benefit gained at each incremental increase in cleanup level. Table 9 shows the cost of cleanup as compared to the average PCB sediment concentration achieved after cleanup in Hylebos Waterway and in the CB/NT Site as a whole. Since fish and fisherpersons are likely to move throughout a waterway or throughout the CB/NT Site, the post-cleanup average gives an idea of the amount of PCB contamination these receptors would be exposed to. At PCB cleanup concentrations between 900 and 450 μg/kg, the environmental benefit in terms of reduction in the post-cleanup average PCB concentration is approximately equal to or greater than the percent increase in volume requiring remediation. Because of the large volume of sediments with PCB concentrations of 450 μg/kg or less, the volume of sediments requiring remediation becomes very high in comparison to the percent reduction in average PCB concentrations.

Table 9. Post-cleanup average PCB concentrations and cleanup costs at a range of PCB sediment cleanup levels.

PCB Sediment Remedial Action Level (μg/kg)	Post-cleanup average concentration (Hylebos Waterway only) (μg/kg)	Post-cleanup average PCB concentration (CB/NT Site) (μg/kg)	Cleanup cost (Hylebos Waterway only) (millions) (1)
150	37	51	$46.5
300	80	63	$31
450	124	75	$18
600	143	82	$15.5
750	156	86	$14.5
900	161	89	$14

(1) Costs presented are Hylebos Waterway cleanup costs only. Bay-wide cleanup costs can be estimated at Hylebos Waterway cost + $18 million (ROD estimated cost for cleanup of all other problem areas).

Based on this analysis, EPA has determined that a PCB SRAL of 450 μg/kg is cost-effective. A remedial alternative is considered "cost effective" if its costs are proportional to its overall effectiveness. Overall effectiveness is determined by evaluating its short-term and long-term effectiveness (and reduction in toxicity, mobility, and volume, in decisions where treatment is being considered), as discussed above. Cleanup to 450 μg/kg PCBs would significantly reduce the overall post-cleanup average PCB concentration, and subsequently, the risks to human health and the environment, in the individual waterways and in Commencement Bay as a whole.

Cleanup to the ROD SRAL of 300 μg/kg PCBs would be significantly more costly (the cost of cleanup to 300 μg/kg is about $13 million higher than the cost of cleanup to 450 μg/kg), while the difference in long-term and short-term protectiveness is not large.

Although the majority of the cost of the cleanup is associated with meeting the SRAL, there are some costs associated with assuring the SQO is met within 10 years after remedial action through natural recovery. These costs are expected to result in a very small increase to the cost of the remedy, as discussed below.

- Natural recovery predictions in the 1989 ROD will be updated with new natural recovery models using pre-design sampling data. This cost of modeling for natural recovery of PCBs will be a negligible addition to the efforts already underway at most CB/NT problem areas to predict natural recovery rates for other chemicals.

- Some additional remedial action may be required in areas where natural recovery models predict that a lower PCB SRAL is needed to achieve PCB concentrations of 300 μg/kg in 10 years after the remedial action. This may require additional remedial action at a few stations, with little impact on the overall cost of the remedy.

- Implementation of this change will require natural recovery monitoring in areas where post-cleanup PCB concentrations are between 450 μg/kg and 300 μg/kg. EPA estimates the cost of monitoring during the 10-year natural recovery period at $310,000 (Weston, 1997d).

- If models incorrectly predict natural recovery rates, additional remedial action will be needed in areas which do not naturally recover to 300 μg/kg PCBs. However, EPA believes that low cost remedial action alternatives can be used to remediate the remaining areas where PCB concentrations fall between 450 μg/kg and 300 μg/kg 10 years after remedial action. Potential remedial action alternatives include but are not limited to enhanced natural recovery, limited capping, or limited dredging, if a disposal site is readily available. EPA's best estimate is that these actions will not be needed, so contingent costs for these actions are not included in EPA's cost estimate. If additional remedial actions do prove necessary, they are expected to cost much less than the current estimated marginal cost of $13 million for full-scale cleanup of areas where sediment PCB concentrations currently fall between 450 and 300 μg/kg.

State and Tribal Acceptance

The State of Washington Department of Ecology concurs with the selected PCB cleanup level. Ecology's concurrence letter is included as Appendix B. The Puyallup Tribe of Indians does not concur with the selected PCB cleanup level.

Community Acceptance

Based on the public comments received during EPA's initial community relations activities associated with the PCB cleanup level and during the public comment period held from March 10 through April 9, 1997, it is clear that the community is divided on this issue. Some members of the community believe the cleanup level should be raised, while many others believe it should remain as stated in the 1989 ROD, or that the PCB standard should be even more stringent than stated in the ROD. Appendix C contains a summary of the comments received during the public comment period and EPA responses to those comments.

Summary of the Comparative Analysis of Alternatives

Based on the human health and environmental risk evaluation, and the comparative analysis of alternatives, EPA is modifying the PCB sediment SQO in the CB/NT ROD to 300 μg/kg, to replace the former SQO of 150 μg/kg. The 300 μg/kg PCB SQO must be achieved in all CB/NT problem areas within 10 years after cleanup. Because of the long-term human health risks associated with PCBs, EPA is also setting a maximum PCB SRAL of 450 μg/kg for the CB/NT Site. The SRAL must be achieved in all CB/NT problem areas during cleanup. EPA's calculations show that an average post-cleanup PCB concentration of less than 150 μg/kg will be achieved in all waterways and in Commencement Bay as a whole after cleanup to the SRAL of 450 μg/kg, and will be reduced to an average of 63 μg/kg within 10 years through natural recovery processes. EPA has selected 300 μg/kg as the appropriate PCB SQO and 450 μg/kg as the maximum PCB SRAL for the CB/NT Site for the following reasons:

- It is within the EPA's acceptable risk range for Superfund cleanups and is protective of human health cancer risks. EPA's human health risk calculations show that a PCB SQO of 300 μg/kg will result in post-cleanup residual risks for persons consuming fish from the CB/NT Site of 1×10^{-4} for the Hylebos Waterway and the CB/NT Site as a whole, and 8×10^{-5} for the Thea Foss Waterway. Residual risks during the 10-year natural recovery period will be only slightly higher, at 1×10^{-4} for the CB/NT Site and Thea Foss Waterway, and 2×10^{-4} for the Hylebos Waterway.

- It meets the NCP standard for non-cancer risks of providing post-cleanup concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety. Although the non-cancer HQ for the high-end tribal fishing scenario is greater than one, EPA believes that there is a sufficient margin of safety built into the estimates of toxicity and exposure to provide for protection of human health.

- The PCB SQO of 300 μg/kg and SRAL of 450 μg/kg are protective of ecological receptors. They are below the 1,000 μg/kg PCB AET calculated in the CB/NT ROD as being protective of benthic infauna. They also falls between Ecology's no adverse effects level and minor adverse effects level as promulgated under the State's SMS to protect aquatic life. The updated ecological risk analysis indicates that the SQO and SRAL are protective of juvenile salmonids, shorebirds, and piscivorous birds.

- A 450 μg/kg SRAL is the most cost-effective alternative. Remediation to a lower cleanup level requires remediation of a substantially larger volume of sediments. Cleanup to the former 300 μg/kg PCB SRAL would result in a 70% increase in the volume of sediments to be remediated in the Hylebos Waterway, and a 150 μg/kg PCB cleanup level would result in a 150% volume increase, when compared to the 450 μg/kg cleanup level. This increased volume would also result in an increase in the cost of cleanup, the area needed for a disposal site, and the area of the Waterway where aquatic organisms are disrupted during dredging.

- The 300 μg/kg PCB SQO provides for additional protection at a small additional cost. By requiring that modeling be done to confirm ROD predictions that PCB concentrations will be reduced by natural recovery processes within 10 years after cleanup, and requiring long-term monitoring and potential additional cleanup to ensure the SQO is achieved, the 300 μg/kg PCB SQO provides additional assurance of the long-term protectiveness of the remedy. Over the 10-year natural recovery period, human health cancer risks would be reduced by an additional 14% for the CB/NT Site as a whole, 34% for the Hylebos Waterway, and 31% for the Thea Foss Waterway. There will be similar reductions in non-cancer risks and ecological risks. EPA believes that establishing a maximum SRAL and a 300 μg/kg SQO is cost-effective, especially since the natural recovery component of the remedy increases the cost of the remedy by a very small amount. Even if natural recovery models have not accurately predicted the rate of natural recovery and additional cleanup is needed to achieve 300 μg/kg PCBs within 10 years after cleanup, low cost solutions such as enhanced natural recovery can be used to remediate sediments with contaminant concentrations between 450 μg/kg and 300 μg/kg PCBs.

IV. DOCUMENTATION OF CHANGES FROM THE PROPOSED ESD

In February 1997, EPA released its draft ESD (EPA, 1997) with a proposed change to the PCB cleanup level. In the ESD, EPA proposed to modify the PCB sediment SQO from 150 μg/kg to be achieved within 10 years after cleanup, to 450 μg/kg, to be achieved during cleanup. EPA received several comments on the proposed ESD, and made some modifications to the proposed remedy in response to public comments and those of the support agencies, the

Washington State Department of Ecology, and the Puyallup Tribe of Indians. The changes made in response to those comments are summarized below.

Addition of a 300 μg/kg PCB SQO

An SQO of 300 μg/kg PCBs has been added as an enforceable standard for the CB/NT Site, along with the 450 μg/kg PCB SRAL proposed in the draft ESD. This means that CB/NT sediments with PCB concentrations of 450 μg/kg or higher will be remediated as part of any CB/NT cleanup. In addition, natural recovery modeling will be performed to ensure that remediation of PCB-contaminated sediments to 450 μg/kg will result in PCB sediment concentrations of 300 μg/kg or below in all areas of the CB/NT Site. If natural recovery models predict that in some areas, a PCB cleanup level lower than 450 μg/kg is needed to achieve 300 μg/kg PCBs within 10 years of sediment remedial action, a lower PCB SRAL will be required in those areas.

The 450 μg/kg SRAL is being set as the maximum PCB SRAL for any problem area at the CB/NT Site. Even if natural recovery modeling shows that some areas with a higher PCB sediment concentration will naturally recover to 300 μg/kg in 10 years, areas with PCB sediment concentrations greater than 450 μg/kg PCBs must be remediated. EPA considers 450 μg/kg PCBs to be the maximum concentration of PCBs which should be allowed at the CB/NT Site after cleanup, because of the long-term health human health and ecological effects associated with PCBs.

Addition of an Analysis of Non-cancer Risks

In the draft ESD, EPA relied on the analysis in the 1989 ROD that a PCB cleanup level which is protective of human health cancer risks is also protective of non-cancer risks. In response to public concerns about non-cancer risks associated with PCBs, EPA performed an analysis of the residual non-cancer risks associated with cleanup of PCBs to a range of potential PCB cleanup levels (Weston, 1997b) and considered this information in its selection of the final PCB cleanup level.

Clarification of CERCLA Requirements for Review of Protectiveness of the Remedy

Several commentors pointed out that a considerable amount of new research is being done on the harmful effects of PCBs. In addition, NOAA continues to do research on the effects of contaminants at the CB/NT Site to wildlife. These studies may, in the future, show that the toxicity of PCBs is greater than currently believed. Section 121(c) of CERCLA states that if EPA selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, EPA shall review such remedial actions no less often than each 5 years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action. Pursuant to this statutory requirement, EPA will review the appropriateness of the remedy no less often than each 5 years after its initiation. If new studies indicate that PCBs are responsible for more toxic effects than was known at the time of this ESD, EPA will review such information to determine whether any additional remedial action is necessary to ensure the protectiveness of the remedy.

V. AFFIRMATION OF THE STATUTORY DETERMINATION

Considering the new information that has been developed in this ESD and in the Administrative Record, EPA believes that the modified PCB SQO and SRAL values for remediation of contaminated sediments at the CB/NT Site remain protective of human health and the environment, comply with Federal, State and tribal requirements that are applicable or relevant and appropriate to this remedial action, is cost-effective, and otherwise meets the standards of Section 121 of CERCLA.

VI. PUBLIC PARTICIPATION ACTIVITIES

EPA developed a report in October 1996 which provided human health risk calculations at a range of potential PCB cleanup levels. That report was sent to several parties for review, and EPA received 20 comment letters. EPA held a public meeting to discuss our proposed approach, which 29 people attended. As noted in Section III of this ESD, EPA made several modifications to its approach to evaluating potential cleanup levels based on these comments.

In February, EPA released its draft ESD (EPA, 1997) with a proposed change to the PCB cleanup level. In the ESD, EPA proposed to modify the PCB sediment cleanup from 150 μg/kg to be achieved within 10 years after cleanup, to 450 μg/kg, to be achieved immediately after cleanup. A fact sheet was sent in March 1997 to over 2000 people announcing EPA's proposed change and inviting their comments. EPA placed a display ad in the Tacoma News Tribune on March 10, 1997 announcing the public comment period and a public meeting. A public meeting was held on March 26, 1997, to present EPA's proposal, to answer questions about the proposal, and to take public comments. This meeting was attended by approximately 50 people. The public comment period for the draft ESD and the Administrative Record (AR) of documents supporting the proposal extended from March 10, 1997 to April 9, 1997. Thirty-six verbal and written comments were received by EPA, and nine comment letters were received after the public comment period ended. All comments, including those received before and after the public comment period, were considered in EPA's decision. The AR for this decision contains all public comments EPA has received on this proposal. Appendix C contains a summary of the comments received before and during the public comment period and EPA responses to those comments.

Signed:

for Randall F. Smith, Director
Office of Environmental Cleanup

July 28, 1997
Date

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Weston 1997c. Technical Memorandum - Risks from Human Consumption of PCB-Contaminated Fish under Background Conditions in Puget Sound. Prepared for U. S. EPA Region 10. July.

Weston. 1997d. Cost Estimate for Natural Recovery Monitoring. Letter to Allison Hiltner, U. S. EPA Region 10. July 23.

APPENDIX A

Table A-1—Arithmetic Mean Residual PCB Sediment Concentrations (μg/kg-DW) over a Range of PCB Cleanup Levels

Target PCB Cleanup Level (μg/kg-DW)	CB/NT Site-Wide	Hylebos Waterway	Thea Foss Waterway
50	45	20	22
100	47	26	34
150	51	37	49
300	63	80	81
450	75	124	108
600	82	143	136
750	86	156	150
900	89	161	168

Table A-2—Assumptions used in Human Health Residual Risk Evaluation

Parameter	Value[1]	Source
PCB oral Cancer Slope Factor (CSF_o)	2.0 $(mg/kg\text{-}day)^{-1}$	Updated toxicity value from EPA's Integrated Risk Information System (IRIS)
Representative PCB Residual Sediment Concentration Statistic	arithmetic mean (see values in Table A-1)	As recommended by EPA
PCB Biota Sediment Accumulation Factor (BSAF)	1.72	Site-specific, bay-wide value
Fraction Lipid in Fish Tissue (f_{lipid})	2.6%	Site-specific, bay-wide value
Exposure Duration (ED)	30 yr	EPA default upper end residency value
Exposure Frequency (EF)	350 days/yr	Standard default exposure factor, allows for 2 weeks away per year
Averaging Time (AT)	70 yr	Standard default human lifetime, used for averaging all cancer risks
Body Weight (BW_a)	70 kg	Average adult human body weight

[1]Shaded values indicate those values that have been revised since the 1989 ROD.

Table A-3—Fish Ingestion Rates used in Human Health Residual Risk Evaluation

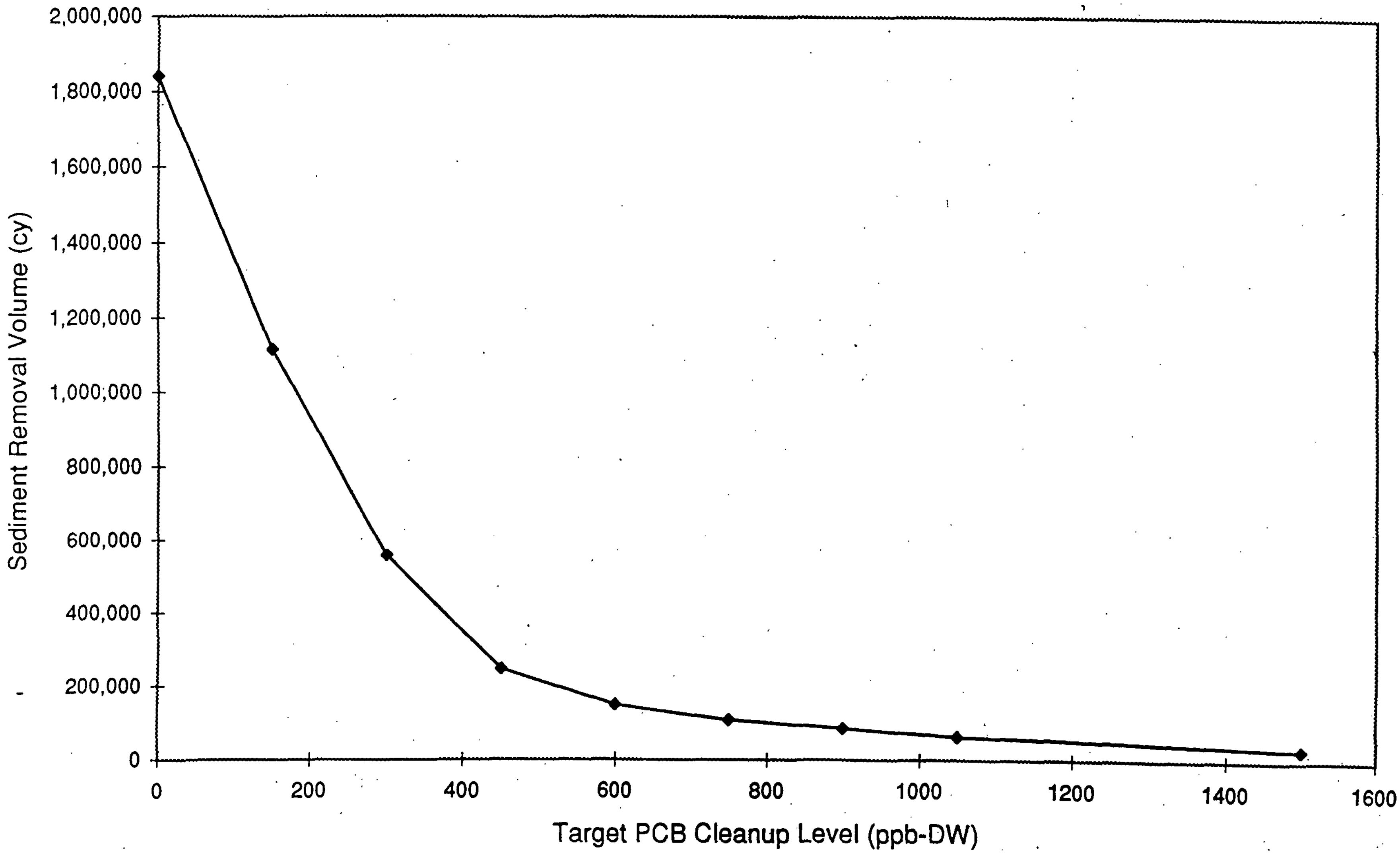
Exposure Scenario	Ingestion Rate (g/day)	Fraction Consumed Fish from the CB/NT Site (%)
RME--High-end Tribal	123[1]	69[5]
Average Tribal	41.7[2]	69[5]
High-end Recreational	95.1[3]	100
Average Recreational	12.3[4]	100

[1] Upper 90th UCL of the mean ingestion rate of all finfish from Toy et al., 1996
[2] Mean ingestion rate of all finfish from Toy et al., 1996
[3] Upper 95th UCL of the mean fish ingestion rate from Tetra Tech composite study utilized in the ROD
[4] Mean fish ingestion rate from Tetra Tech composite study used in the ROD
[5] Weighted average (based on mean consumption rates by each tribe of each type of fish) of percentages of finfish consumed from Puget Sound from Toy et al., 1996

Table A-4-Estimated Residual Cancer Risks after cleanup to a range of PCB cleanup levels

Target PCB Cleanup Level (μg/kg-DW)	CB/NT Site-Wide	Hylebos Waterway	Thea Foss Waterway
50	8.3E-5	2.7E-5	2.1E-5
100	8.7E-5	3.4E-5	3.3E-5
150	9.4E-5	4.9E-5	4.6E-5
300	1.2E-4	1.1E-4	7.6E-5
450	1.4E-4	1.6E-4	1.0E-4
600	1.5E-4	1.9E-4	1.3E-4
750	1.6E-4	2.1E-4	1.4E-4
900	1.6E-4	2.1E-4	1.6E-4

Figure A-1--Hylebos Waterway Target PCB Cleanup Level vs Sediment Removal Volume



SOURCE: Memorandum from Paul Fugelvand (Dalton, Olmsted Fuglevand, Inc.) to Allison Hiltner (US EPA) Regarding PCB Residual Concentration, Arithmetic Mean. December 18, 1996.

2/26/97 3:55 PM

APPENDIX B

WASHINGTON DEPARTMENT OF ECOLOGY LETTER SUPPORTING EPA'S EXPLANATION OF SIGNIFICANT DIFFERENCES

Allison

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

RECEIVED
JUN 17 1997
Environmental Cleanup Office

June 13, 1997

Mr. Randy Smith
Environmental Protection Agency
1200 6th Avenue, ECL-117
Seattle, WA 98101-3188

Dear Mr. Smith:

We appreciate having the opportunity to review and comment upon Environmental Protection Agency's Explanation of Significant Differences regarding PCBs in Commencement Bay. As you know, we've been attempting to evaluate whether your proposal will meet objectives of Washington's sediment management program after the cleanup is completed.

As the proposal currently stands, the termination of cleanup after dredging to 450 ppb will not achieve a level of protection for humans or wildlife that will meet Ecology's requirements. Ecology's goals for acceptable human health risk for carcinogens are 1 x 10-6 to 1 x 10-5 and for noncarcinogens, hazard indices for human or ecological health are not to exceed a value of one (Chapter 173-340-700 WAC).

There are, however, some very positive aspects to Environmental Protection Agency's proposal. We support the concept of removal through dredging and confined disposal and we desire to see the cleanup proceed promptly. While the proposed cleanup to 450 ppb falls short of Ecology objectives, we would endorse the implementation of a 10 year natural recovery period as an element of the cleanup to achieve further reduction of PCBs. This is consistent with the State's Sediment Management Standards where cleanup of heavier contaminated areas is undertaken initially, followed by natural recovery in areas of relatively lower concentrations.

Natural recovery would be considered appropriate by the State only if active cleanup is taken to 450 ppb at year 0 and PCBs are at or below 300 ppb at year 10 after cleanup. This ensures short term effectiveness of the remediation by limiting risk to human health and the environment over the 10 year recovery period and long term effectiveness is attributed to the final cleanup standard of 300 ppb. Also, a monitoring program to track natural recovery would have to be included. Additional active remediation would be triggered if monitoring indicates that the 10 year objective (300 ppb) would not be achieved.

Ecology's concurrence with EPA's cleanup is conditioned on the following points:

- Active Remediation to 450 ppb PCBs throughout Commencement Bay
- Recovery within ten (10) years to a maximum level of 300 ppb
- Monitoring to confirm recovery will be achieved
- Additional remedial action triggered if recovery will not meet cleanup levels
- Cleanup action to commence no later than year 2001

Ecology's has determined that this cleanup scenario ensures significant additional risk reduction with minimal additional costs expected. Over the 10 year period of natural recovery, mean concentration for PCBs would decrease from about 124 to 80 ppb for Hylebos, from 108 to 81 for Thea Foss and from 75 to 63 Bay-wide. Concurrently, human health cancer risks would be reduced by about 34%, 31%, and 14% (Hylebos, Thea Foss and Bay-wide, respectively) for the scenario that is protective of the above average Tribal subsistence fisher. Non-cancer human health hazard quotients would decrease from 9 to 6 for Hylebos, from 6 to 4 for Thea Foss and from 8 to 7 for Bay-wide and, hazard indices for 3 groups of wildlife (juvenile salmonids, shorebirds and piscivorous birds) would be reduced below one.

We believe our concepts could achieve a cleanup that makes great progress in meeting state requirements without substantial cost increases. We also recognize the difficult job the Environmental Protection Agency has in attempting to reconcile the many views presented to you and we hope that our ideas might help bring the project to a successful conclusion for all of the parties involved.

Sincerely,

Mary E. Burg

Mary Burg
Program Manager
Toxics Cleanup Program

MB:jr

cc: Dave Jansen, Ecology
Russ McMillan, Ecology

APPENDIX C

PUBLIC COMMENT RESPONSIVENESS SUMMARY

July 28, 1997

TABLE OF CONTENTS

PCB CLEANUP LEVEL REEVALUATION
COMMENCEMENT BAY NEARSHORE/TIDEFLATS SUPERFUND SITE
PUBLIC COMMENT RESPONSIVENESS SUMMARY

A. OVERVIEW OF THE REEVALUATION OF THE PCB CLEANUP LEVEL AND RELATED COMMUNITY INVOLVEMENT

In 1983, the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site was placed on EPA's National Priorities List (NPL) of sites requiring investigation and cleanup. In 1989, the Record of Decision (ROD; EPA, 1989a) addressing the marine sediment problem areas within the CB/NT Site was released. The ROD addressed the seven waterways (i.e., the Hylebos, Blair, Sitcum, Milwaukee, Saint Paul, Middle, and Thea Foss/Wheeler-Osgood waterways) extending southeast from Commencement Bay, and the Nearshore area (i.e., area from the Commencement Bay shoreline to the 60-foot bathymetric contour) of the bay. (See Figure 1 in the Explanation of Significant Differences [EPA, 1997a].) It did not include the Ruston shoreline, which will be addressed in a separate ROD. The CB/NT ROD established a sediment quality objective (SQO) for polychlorinated biphenyl compounds (PCBs) of 150 micrograms per kilogram (μg/kg, dry weight) based on protection of human health from ingestion of contaminated fish. The 150 μg/kg SQO was to be met within 10 years of active sediment cleanup.

During pre-design sampling, new data were collected from the Hylebos Waterway showing that approximately twice the amount of sediment originally estimated in the ROD would require cleanup; and EPA has updated the toxicity information it used to assess human cancer risks associated with PCBs. In response to concerns about these issues, EPA decided to reevaluate the PCB sediment cleanup level for the CB/NT Site. The *Evaluation of Residual Risks Associated with a Range of Sediment PCB Cleanup Levels in the Hylebos Waterway, the Thea Foss Waterway, and the Overall Commencement Bay Nearshore/Tideflats Superfund Site* (referred to as the Evaluation of Residual Risks) was prepared in October 1996 to form a technical basis for the reevaluation of the PCB cleanup level (Weston, 1996). The report quantitatively evaluated residual risks to human health at a variety of potential PCB cleanup levels using updated sediment data, and the risk calculation and exposure assumptions in the 1989 ROD. It also contained an uncertainty analysis which qualitatively evaluated the impact of varying the assumptions used in the risk estimates. EPA distributed the Evaluation of Residual Risks report (Weston, 1996) to 31 parties and held a comment period in November 1996. EPA held an informational meeting attended by approximately 29 people on November 4, 1996, at the World Trade Center in Tacoma, Washington. EPA received approximately 20 comment letters during this informal comment period.

In response to comments on the Evaluation of Residual Risks report, EPA updated the risk equations and several of the input parameter values. This analysis was released in February 1997 as the Addendum to the Evaluation of Residual Risks (Weston, 1997a). As with the Evaluation of Residual Risks, the Addendum presents residual human cancer risks at potential target PCB sediment cleanup levels from 50 to 900 μg/kg. In addition, the Addendum includes a brief evaluation of ecological risks over a range of PCB cleanup levels. EPA considered the information presented in both the Evaluation of Residual Risks and the Addendum in its reevaluation of the PCB cleanup level.

In February, EPA released its draft Explanation of Significant Differences (ESD) (EPA, 1997a) with a proposed change to the PCB cleanup level. In the ESD, EPA proposed to modify the PCB sediment cleanup from 150 μg/kg to be achieved within 10 years after cleanup, to 450 μg/kg, to be achieved during cleanup. A fact sheet was sent in March 1997 to over 2,000 people announcing EPA's proposed change and inviting their comments. EPA placed a display ad in the *Tacoma News Tribune* on March 10, 1997, announcing the public comment period and a public meeting. A public meeting was held on March 26, 1997, to present EPA's proposal, to answer questions about the proposal, and to take public comments. This meeting was attended by approximately 50 people. The public comment period for the draft ESD and the Administrative Record of documents supporting the proposal extended from March 10, 1997, to April 9, 1997. Thirty-six verbal and written comments were received by EPA.

This Responsiveness Summary addresses comments on the October 1996 Evaluation of Residual Risks report (Weston, 1996) as well as comments shared with EPA during the public comment period following release of the draft ESD.

B. OVERVIEW OF COMMUNITY CONCERNS AND EPA RESPONSE

Comments received by EPA on the October 1996 Evaluation of Residual Risks report (Weston, 1996) ranged from concerns that the risk calculations were overly conservative and would result in an unnecessary degree of cleanup to concerns that any increase to the existing PCB cleanup level (150 μg/kg) would not be adequately protective of people and wildlife in the vicinity of the CB/NT Site. Commentors requested the use of more up-to-date values to calculate site risks. Concerns were expressed regarding the value chosen to represent the residual PCB sediment concentrations after cleanup at the selected target cleanup levels. Commentors also requested that ecological risks associated with PCB exposure be more directly addressed.

Many of the comments requesting that EPA use updated values in its risk calculations were addressed in the February 1997 Addendum to the Evaluation of Residual Risks (Weston, 1997a). A new cancer slope factor, exposure duration, and fish consumption rate, along with updated sediment chemistry data (for PCB concentrations and total fraction of organic carbon), were used in risk calculations. A brief evaluation of risks to selected ecological receptors was performed using data provided by the natural resource agencies.

Many of the concerns expressed in November 1996 were repeated during the March 1997 public comment period, along with several additional concerns. Although some commentors agreed with EPA's proposed PCB cleanup level of 450 μg/kg, many commentors expressed concerns that the proposed cleanup level was too high or too low. Some felt that it was not adequately protective of people and ecological receptors in the vicinity of the site, while others felt that it mandates a higher cost than other potential cleanup levels (e.g., 600 μg/kg) without providing a significant increase in protectiveness. Commentors also questioned EPA's application of the nine Superfund evaluation criteria discussed in the ESD in relation to establishing the proposed new PCB cleanup level. Additionally, commentors cited a need to account for multiple chemical effects and global distributions of PCBs. Several commentors expressed concerns about non-cancer risks associated with PCBs. Some commentors were also concerned about the feasibility of cleaning up sediments to a 450 μg/kg PCB cleanup level and the potential for increased ecological risks during the remedial efforts.

In making its final decision on the PCB cleanup level for Commencement Bay sediments, EPA carefully examined data regarding cancer and non-cancer risks to both people and the environment to ensure that the proposed PCB cleanup level would be protective of both human health and the environment. In response to concerns about non-cancer human health risks, EPA evaluated potential non-cancer risks in a technical memorandum entitled "Potential for Noncancer Health Impacts from PCBs in Commencement Bay Sediments" (Weston, 1997b). This technical memorandum has been added to the Administrative Record for this ESD. EPA also added to the Administrative Record a technical memorandum on PCB concentrations in non-urban areas of Puget Sound (Weston, 1997c) to address questions about background conditions. To address concerns that EPA should provide some assurance PCB concentrations will be reduced over time, EPA added a requirement that PCB concentrations in sediments must be reduced to 300 μg/kg within 10 years after completion of the cleanup. If the 300 μg/kg standard is not achieved through natural recovery, additional cleanup work will be done to meet that standard.

Specific responses to the concerns expressed by commentors are provided in the following subsections within Section C:

Part I — Responses to Comments Received Prior to Issuance of the Draft ESD
1. Comments Regarding the Risk Evaluation Approach
2. Comments Regarding Risk Management Issues

Part II — Responses to Comments Received Subsequent to Issuance of the Draft ESD
3. Comments Related to the Proposed PCB Cleanup Level
4. Comments Related to the Risk Evaluations
5. Comments Related to Remedial Decision-Making

Part III - List of Commentors

Part I, which comprises sections 1 and 2, focuses on comments received during the 1996 comment period following release of the Evaluation of Residual Risks (Weston, 1996). Part II, which comprises sections 3 through 5, focuses on comments received during the 1997 public comment period following release of the draft ESD and supporting information, including the Addendum (Weston, 1997a). The responses to comments are followed in Part III by a list of the commentors. References are listed in Section D. Several technical terms are used in the comments and responses. To assist the non-technical reader, technical terms are defined in the glossary provided in Section E.

C. RESPONSES TO SPECIFIC PUBLIC CONCERNS

Part I—Responses to Comments Received Prior to Issuance of the Draft ESD

1 Comments Regarding the Risk Evaluation Approach

1.1 Comments related to use of up-to-date values for toxicity and exposure parameters and an up-to-date equation for calculating residual risks

1.1.1 The cancer slope factor in EPA's Integrated Risk Information System has been reduced from 7.7 (mg/kg-day)$^{-1}$ to a range of 0.04 - 2.0 (mg/kg-day)$^{-1}$. EPA's risk evaluation should use the more updated cancer slope factor to evaluate residual risk. (17, 14, 15, 6, 32)

> **Response:** EPA agrees and has applied the updated oral cancer slope (toxicity) factor of 2.0 (mg/kg-day),$^{-1}$ as recommended for food chain exposures such as fish consumption, in the assessment of residual risks presented in the Addendum to the Evaluation of Residual Risks Report (Addendum; Weston, 1997a). The Addendum contains the residual risk calculations used by EPA in its reevaluation of the PCB cleanup level for the CB/NT Site.

1.1.2 EPA could simply update the PCB cancer slope factor (CSF), leave all other exposure assumptions unchanged, and the PCB cleanup criterion for the Hylebos would become consistent with other RODs in the nation. Updating only the cancer slope factor in the ROD risk assessment, without changing any of the other out-dated exposure assumptions, would change the PCB cleanup criteria from 150 μg/kg to 1,500 μg/kg. If the cancer slope factor decreases from 7.7 to 2 (a decrease by a factor of 3.85) and all other parameter values remain the same (including risk), the allowable PCB concentration in fish will increase by a factor of 3.85 to 139 mg/kg. The corresponding PCB concentration in sediment will then increase to 116 mg/kg. Using the tables from Appendix B of EPA Region X's October 1996 report (Weston, 1996), a geometric mean concentration (the parameter used by EPA) of 116 mg/kg corresponds to a cleanup level of 1,500 mg/kg. By making only this one change, a roadblock to cleanup of the Hylebos would be removed without having to conduct any additional studies or risk assessments. (17, 22)

> **Response**: As addressed in Comment 1.1.1, the updated cancer slope factor was applied to the calculation of residual risks presented in the Addendum (Weston, 1997a). However, while reducing the cancer slope factor would decrease residual risk estimates, that alone would not reflect other key changes EPA has made to exposure

values used to calculate human health risks. In the eight years since the 1989 CB/NT ROD, EPA made changes in several exposure assumptions based on new research and new EPA policies. For this reason it would have been inappropriate to update one parameter value without examining all parameter values. Furthermore, as discussed in response to Comment 1.2.2, it is more appropriate to use the arithmetic mean, not the geometric mean, to represent residual sediment concentrations of PCBs at the CB/NT Site. The Addendum includes an analysis of residual risks utilizing both updated toxicity information and updated exposure scenarios relevant to the CB/NT Site.

1.1.3 Updated data sets should be used where practical (e.g., PCB cancer slope factors, total organic carbon in sediment, biota-sediment accumulation factors (BSAFs) for PCBs from other analyses, seafood consumption rates). (2, 33, 4, 31, 21, 8, 32, 6)

Response: As noted in the responses to Comments 1.1.1 and 1.1.2, updated information concerning the cancer slope factor, as well as the exposure factors (e.g., the ingestion rate), were applied to the calculation of residual risks presented in the Addendum (Weston, 1997a). Updated parameter values were used for the cancer slope factor, the fish ingestion rate, the exposure duration, exposure frequency, and the total organic carbon fraction in the sediment. The biota-sediment accumulation factor (BSAF) value for PCBs used in the ROD was retained because it was based on site-specific data.

1.1.4 The result of incorporating more recent values for risk parameters would undoubtedly decrease overall risk. Because EPA's report used outdated assumptions and generic values instead of current science and site-specific data, it is clear that the risk assessment should have been updated. (17)

Response: As discussed in the response to Comment 1.1.3, the risk equation input parameter values were updated for all relevant parameters. However, all parameter value changes did not result in a lowering of the risk estimates. For example, while the lower toxicity factor decreased risk estimates, the higher fish ingestion rate increased the risk estimates.

1.1.5 Some of the exposure parameter values used by EPA in their risk assessment are in excess of those appropriate for estimating a reasonable maximum exposure (RME) such as exposure duration and exposure frequency. EPA research has already established that the average exposure duration is nine years, with 30 years as the reasonable maximum. (17)

Response: A 70-year exposure duration and an exposure frequency of 365 days per year were applied to risk calculations in the 1989 ROD and the October 1996 Evaluation of Residual Risks (Weston, 1996). To be consistent with updated EPA policy, a 30-year exposure duration and an exposure frequency of 350 days per year were applied to risk calculations in the Addendum (Weston, 1997a). The 350 days per year exposure frequency assumes two weeks away from home per year. EPA guidance calls for a nine-year average and a 30-year high-end exposure duration based on fixed locations for exposure such as living next to a Superfund site and assumes that people change residences every nine years (on average). This assumption does not account for the fact that many people, when they move, stay within the region and likely retain use of the same recreational areas (e.g., Commencement Bay). Since data were not available to describe residence time in larger areas, EPA's high-end default value of 30 years was used to represent exposure duration for average and high-end exposure scenarios for PCBs at the CB/NT Site.

1.1.6 EPA justifies an exposure duration of 70 years because PCBs bioaccumulate and have an extended half-life in the body. Using bioaccumulation to justify an extended exposure duration is inconsistent with EPA Headquarters' policy, as documented in EPA's current Integrated Risk Information System (IRIS) file for the PCB cancer slope factor. (17)

As noted in the response to Comment 1.1.5, an exposure duration of 70 years was used in the October 1996 Evaluation of Residual Risks (Weston, 1996) to be consistent with the 1989 CB/NT ROD. Exposure duration was reduced to 30 years in the Addendum (Weston, 1997a). In EPA's most recent evaluation of PCB toxicity, as documented in IRIS (EPA, 1997b), no quantitative factor was provided to account for continued exposure to PCBs from the slow release of PCBs from fatty tissue within a person's body. In neither the Evaluation of Residual Risks (Weston, 1996) nor the Addendum (Weston, 1997a), was this potential exposure factored into the risk estimates. However, in both documents, this potential impact to PCB toxicity was discussed in the uncertainty analysis so that EPA could consider this factor, at least qualitatively, in its reevaluation of the PCB cleanup level.

1.1.7 National guidance calls for risk assessments to evaluate risk for both the average exposure and the reasonable maximum exposure (RME). Based on their choice of parameter values in the October 1996 report, EPA Region X has assessed the RME. (17)

Response: The PCB cleanup level in the 1989 ROD was based on a risk analysis using fish consumption rates for an average recreational fisher. The Evaluation of Residual Risks (Weston, 1996) applied that scenario as a reasonable exposure scenario for the Site. As noted in responses to several of the previous comments, several adjustments to the risk assessment input parameters were needed to update the risk assessment to develop what would be considered a reasonable maximum exposure (RME) under current EPA guidance. The analysis of residual risks presented in the Addendum (Weston, 1997a) included evaluations of average and high-end recreational fisher scenarios, as well as average and high-end tribal fisher scenarios. EPA chose the high-end tribal fisher scenario to represent the RME for the CB/NT Site.

1.1.8 EPA did not reduce the concentration of PCBs in fish as a result of cooking in spite of the fact that the decrease has been documented in the scientific literature. (17)

Response: As discussed in the uncertainty analysis in the Evaluation of Residual Risks (Weston, 1996), reduction of PCB levels in fish following cooking was considered. It is recognized that the various methods of preparing fish for consumption may affect concentrations of PCBs in tissue consumed. Although some studies report that cooking can substantially reduce PCB concentrations in fish tissue, other studies have shown that PCB loss during cooking may be as little as two percent. Some cooking methods also activate or create other carcinogenic chemicals. Because of the uncertainties about the net effects of cooking on PCB concentrations in fish tissue, quantitative corrections for the effects of cooking in the risk assessment are not possible at this time.

Furthermore, even if the PCB content in fish tissue decreased, content of the "pan juices" may include lost PCB amounts from the fish tissue; should these "pan juices" be consumed (e.g., used to make a sauce, or directly poured over the fish), the decrease in PCB fish tissue levels will be balanced, and individuals may still be exposed to nearly one hundred percent of PCBs present in the fish tissue. Also, some cooking methods remove far less PCBs than others; therefore, EPA's assumption of 100 percent of PCBs remaining after cooking was considered appropriate to ensure that derived cleanup levels would be protective of individuals who prepare their fish any number of ways.

1.2 Comments related to the calculation of residual PCB sediment concentrations

1.2.1 The statistical assumptions and methods used for the calculation of the residual sediment PCB concentrations (such as the use of half the sample's reported detection limit for a concentration value) do not appear to be completely supported by the data and could result in a bias (lowering) of the risk estimate. (8)

Response: Use of half the sample detection limit as the concentration for an undetected analyte is consistent with EPA risk assessment methodology. It assumes that the actual PCB concentrations are evenly distributed between zero and the detection limit, and may either over- or underestimate the true concentration (resulting in either an elevated or lowered estimate of risk). These possibilities are acknowledged in the uncertainty analysis presented in the Evaluation of Residual Risks (Weston, 1996) and the Addendum (Weston, 1997a) reports. EPA considered these uncertainties in its reevaluation of the PCB cleanup level.

1.2.2 The assumption of a lognormal distribution for the data set does not appear to be completely supported by the data and could result in a bias (lowering) of the risk estimate. The uncertainty associated with use of the geometric mean should be discussed. (8, 2)

Response: In preparation of the Evaluation of Residual Risks report (Weston, 1996), the distribution of the PCB concentration data was generally found to be lognormal for the individual waterways and for the overall CB/NT Site. This follows the theoretical distribution of most environmental chemical data. Based on this analysis, a decision was made to assume a lognormal distribution; therefore, a geometric mean concentration was used to represent the average residual PCB sediment concentration in the Evaluation of Residual Risks report (Weston, 1996).

However, because use of the geometric mean concentration is not consistent with current EPA risk assessment policy (EPA, 1992), the analysis presented in the Addendum (Weston, 1997a) applied the arithmetic mean residual PCB sediment concentration. Use of the arithmetic mean provided a more conservative representation of the residual PCB concentration to which fish would be exposed and, therefore, allowed for the possibility that some fish may be exposed to higher than average concentrations of PCBs in the sediments due to a limited home range or a preference for feeding in the more contaminated areas. See also EPA's response to Comment 4.1.2.

1.2.3 The arithmetic mean is appropriate regardless of the pattern of daily exposure over time or the type of statistical distribution that might best describe the sampling data. The geometric mean of a set of sampling results, however, bears no logical connection to the cumulative intake that would result from long-term contact with site contaminants, and it may differ appreciably from - and be much lower than - the arithmetic mean...Thus, preferential feeding by smaller forage fish in the more contaminated intertidal areas, ultimately results in a greater body burden in the larger fish that feed on these fish, than would be estimated by either an arithmetic mean, or an area-weighted average. (24)

Response: As discussed in the response to Comment 1.2.2, the arithmetic mean residual PCB sediment concentration was used in the risk evaluations presented in the Addendum (Weston, 1997a).

1.2.4 The original EPA assessment considered a population that is a hybrid between the RME and the average exposure. For example, the fish consumption value is for average exposure; the concentration value is the geometric mean of PCB concentration in fish which is lower than both the arithmetic mean (which according to EPA guidance, should be used to assess average exposure) and the 95th percent confidence interval on the mean (which according to EPA guidance, should be used to assess the RME). (17)

Response: As noted in previous comments, EPA agrees that the evaluation of risks in the 1989 ROD is not consistent with current EPA guidance for estimating either an average or a reasonable maximum exposure (RME). Both the fish consumption value and the residual sediment concentrations were modified in the risk evaluation presented in the Addendum (Weston, 1997a). As discussed above in response to Comment 1.1.7, four exposure scenarios were evaluated, the RME scenario being represented by an high-end tribal fisher. As discussed in response to Comment 1.2.2, the arithmetic mean was used to represent the residual PCB sediment concentration used in risk calculations in the Addendum (Weston, 1997a). See the response to Comment 4.1.2 for a discussion of use of the 95th percent upper confidence level.

1.2.5 On the basis of demographic and fish consumption information for this region, it is unlikely that a large number of individuals would obtain a large percentage of the fish they consume from either the Hylebos or Thea Foss/Wheeler Osgood Waterways within the CB/NT site. Therefore, the range in risk represented by the entire Site should be used as the basis for decisions. (2)

Response: EPA agrees.

1.2.6 The analysis as presented does not provide enough information to evaluate the effects on risk estimates of raising SQOs for CB/NT. Information that would allow such an evaluation include: analysis of the adequacy of the available sediment samples for determining a geometric mean of sediment for the CB/NT Site. (2)

Response: Analyses of sample adequacy and the uncertainty associated with using sediment samples to estimate fish tissue concentrations are qualitative analyses. However, over the past three years, more than 200 sediment samples have been collected from each of the Hylebos and the Thea Foss waterways, waterways in which PCBs were identified as a major contaminant of concern. These samples were incorporated into the residual risks estimated in both the Evaluation of Residual Risks (Weston, 1996) and the Addendum (Weston, 1997a). EPA considers this an adequate number of samples to characterize PCB levels. Use of the geometric mean is further discussed in responses to Comments 1.2.2 and 4.1.2.

1.2.7 The analysis as presented does not provide enough information to evaluate the effects on risk estimates of raising SQOs for CB/NT. Information that would allow such an evaluation include presentation of the pre-cleanup geometric mean sediment level and discussion of the drop in geometric mean sediment levels under each SQO in relation to the desired drop in fish PCB levels from 330 μg/kg (i.e., ratio of pre-cleanup sediment and fish tissue level should be equivalent to ratio of post-cleanup sediment and fish tissue level). (2)

Response: The information requested in this comment is presented in Tables 3-2, 3-3, and 3-4 of the Evaluation of Residual Risks (Weston, 1996). As stated in this report, it is assumed that there is a linear relationship between the residual sediment PCB concentration and the fish tissue PCB concentration.

1.3 Comments related to uncertainties associated with the residual risk estimates

1.3.1 EPA claimed that uncertainty related to the several factors in the risk equation would balance out because of perceived changes in several of them, affecting the risk estimates in both directions. This rationale does not address the question of magnitude, where one or a few factors carry significant weight or value in the equation. The analysis as presented does not provide enough information to evaluate the effects on risk estimates of raising SQOs for CB/NT. Quantitative description of uncertainty and variability in the data should be incorporated into the risk estimates. (2, 33, 8)

Response: Qualitative and semi-quantitative uncertainty analyses were conducted for the Evaluation of Residual Risks (Weston, 1996) and are summarized in the Addendum (Weston, 1997a). EPA did not attempt a quantitative uncertainty analysis because it would have been an extremely difficult undertaking, and would have been only marginally more useful than the qualitative uncertainty analysis for the purposes of decision-making. Uncertainty is inherent in most risk calculations due to natural variability and uncertainty in various input parameters, some of which can, and some of which cannot, be quantified. EPA considered all uncertainties linked with residual risk estimates presented in both the Evaluation of Residual Risks (Weston, 1996) and the Addendum (Weston, 1997a) in its reevaluation of the PCB cleanup level for the CB/NT Site.

1.3.2 This proposed SQO represents a potential concern because nonionic organics (including PCBs) require normalization to total organic carbon (TOC) to reduce a major source of variability which are attributed to the differences in the amount of carbon....given that the organic carbon data from Hylebos Waterway and Thea Foss/Wheeler-Osgood Waterway range from approximately 0.4 to 13.5 percent (Table A-1) and from 0.3 to 16 percent (Table A-7) respectively; this could result in an error between one to two orders of magnitude (ten to one hundred fold) based upon sampling alone. (12)

Response: As described in the first equation in Section 2.2 of the Evaluation of Residual Risks (Weston, 1996), the fraction of total organic carbon (TOC) in sediment is accounted for in the calculation of the residual PCB fish tissue concentration from PCB sediment concentration. In the Addendum (Weston, 1997a), the TOC values were updated to reflect current sampling data. The fraction of total organic carbon was calculated for the overall CB/NT Site, for the Hylebos Waterway, and for the Thea Foss Waterway, using data collected over the past three years. EPA considers this application of average organic carbon fractions representative of the range of organic carbon fractions throughout the CB/NT Site, including its waterways, and considers this appropriate for use in the evaluation of residual risks.

1.3.3 Fish tissue concentrations should always be expressed in terms of a lipid-normalized value when dealing with nonionic organic chemicals. This reduces the variability that lipid (fat) has on sample concentrations. (12)

Response: EPA recognizes the need to account for lipid normalization when evaluating the bioaccumulation of PCBs from sediment into fish tissue. Lipid normalization is addressed via the first equation in Section 2.2 of the Evaluation of Residual Risks (Weston, 1996) and via equation 2 in the Addendum (Weston, 1997a). The fraction of fish lipid content is included in the calculation of the residual PCB fish tissue concentration. The fraction used in this calculation was a site-specific value calculated in support of the ROD (EPA, 1989a). Additionally, this same fraction of fish lipid was applied to residual risk calculations presented in the Addendum (Weston, 1997a).

1.3.4 When PCBs are not present, it cannot be concluded that if other chemicals are cleaned up to levels which are protective of ecological endpoints, that these levels would also be considered protective of human health. All chemicals with a log K_{ow} value of greater than 5 should be examined to ensure that sediment criteria that are based on human health do not suggest a lower cleanup level than ecological criteria values. (12)

Response: In developing the 1989 ROD, EPA used a human health risk assessment to determine which chemicals may cause a human health threat to consumers of fish and shellfish. It was determined that only PCBs were present in sufficiently high concentrations in fish and shellfish to pose a threat to humans. Therefore, the ecologically based cleanup criteria for all contaminants except PCBs will result in residual contaminant concentrations that are protective of human health.

1.4 Comments related to exposure scenarios evaluated

1.4.1 While the 1981 Pierce survey did not address waterway by waterway use of the bay, 25 percent of respondents reported fishing or harvesting shellfish in the Commencement Bay area. This summer, a CHB volunteer pollution monitor in the Hylebos Waterway witnessed a commercial trawler harvesting fish from the waterway. CHB's survey and monitoring of the bay and its waterways clearly illustrate that people are using the area for fishing. Protection of the community's health must remain a priority when considering any change in the PCB cleanup level. (8)

Response: EPA agrees that protection of human health must be a primary consideration in its reassessment of the PCB cleanup level for the CB/NT Site. EPA's policy is to base its risk assessments on a "reasonable maximum exposure" scenario. Because the CB/NT Site is part of the usual and accustomed fishing grounds for the Puyallup Tribe, EPA modified its assumptions for fish consumption rates from those presented in the 1996 Weston report to reflect a tribal fishing scenario. The 1997 Weston Addendum evaluates risks to a tribal member who consumes a higher than average amount of fish from the CB/NT Site. By protecting tribal members, who generally consume more fish than recreational fishermen, EPA believes it is setting cleanup levels which are protective for all members of the community.

1.4.2 Subsistence fishing is no longer done by the Tribes, not just because of contamination, but because times have changed. (21)

Response: EPA policy and regulations require that Superfund sites be cleaned up to concentrations low enough to be protective under both current and reasonably likely future uses for a site. EPA guidance requires that we evaluate risks associated with the "highest level of exposure and risk that can be reasonably expected to occur" for anticipated future uses of the site (EPA, 1991). Members of the Puyallup Tribe have treaty rights to fish in Commencement Bay. In addition, members of the Tribe have indicated to EPA that they would fish more in Commencement Bay if the contaminated sediments were cleaned up and they were not concerned about eating contaminated fish (see Comment 1.4.3). For these reasons, EPA believes that a tribal fishing scenario is an appropriate scenario to consider in the reevaluation of PCB sediment cleanup levels.

1.4.3 Many activities including recreation, fishing, and shellfishing, are no longer being pursued by the Tribe due to the negligence of industry in the Hylebos Waterway. (29)

Response: As indicated in response to Comment 1.4.2, EPA requires that both current and reasonably likely future uses for a site be evaluated. EPA acknowledged potential use of the CB/NT waters by the Tribe and, therefore, considered risks to tribal fishers in the Addendum (Weston, 1997a).

1.4.4 There is no documented subsistence fishing in the Hylebos Waterway. As noted by EPA, the Pierce et al. study (1981) did not document subsistence fishing activities in the Commencement Bay area. Although we do not dispute that more intensive fishing can be associated with Native American culture or subsistence factors, the cited studies are not relevant to Hylebos for the following reasons..Although Native Americans fish in Commencement Bay and in the Puyallup River, there is no evidence of Native American fishing in the Hylebos. In fact, site-specific data (Pierce et al., 1981) found only one Native American catching fish in the entire summer survey and none in the fall survey out of the about 500 total individuals surveyed for the entire area. (17)

Response: See response to Comment 1.4.2. Data on current practices alone are not always sufficient to evaluate potential future exposures, such as that resulting from an increase in Native American or subsistence fishing. Additionally, it should be noted that the design of the Pierce *et al.* study may have underestimated fish catch by the subsistence fishing population. Subsistence fishers often harvest at different times than recreational fishers, so they may have not been present at times when the surveyors were observing. Also, subsistence fishers may be less likely to share information with surveyors. The RME scenario evaluated by EPA was based on a fish consumption survey for Native Americans in the Puget Sound area. This scenario, with its relatively high consumption rate, is expected to be protective of non-tribal subsistence fishers as well.

1.4.5 Prior to changing the existing cleanup level for PCBs, it would be beneficial to assess current fish consumption rates (the old data were collected prior to the installation of the Les Davis Pier and the posting of the waterways with fish consumption warning signs). (34)

Response: As noted in responses to Comments 1.4.1 and 1.4.2, EPA requires that both current and reasonably likely future use of a site be evaluated. Fish consumption rates used in the ROD for the recreational fisher were determined by examination of four different consumption studies, including the Pierce *et al.* study (1981). To calculate risks to the reasonably maximally exposed individual, EPA used high-end tribal fish ingestion rates as reported in a 1996 study representing two tribes from the

Puget Sound area (Toy *et al.*, 1996). EPA considered these fish ingestion data as the most representative data to account for current and potential future human exposures. A study conducted to assess current use of the CB/NT waters would be confounded by the fact that several measures, including the posting of warning signs by the Tacoma-Pierce County Health Department (TPCHD), have been taken to discourage fishing in CB/NT waters. Therefore, a study of current conditions would not necessarily address potential future uses. Furthermore, fish consumption studies require a considerable amount of time. Conducting additional consumption studies at this time would involve a large time delay in cleanup. Because available data are considered of adequate quality, EPA does not believe that additional studies are warranted at this time.

1.4.6 Documentation should be provided to substantiate EPA's assumption that although the number of people may be small, some individuals gather 100 percent of their fish from the Hylebos Waterway. (17)

Response: EPA is unaware of any documentation on whether or not some individuals currently collect fish exclusively from the Hylebos Waterway. However, EPA must make cleanup decisions based on current and potential future exposure scenarios. For the CB/NT Site, EPA is basing its PCB cleanup decision primarily on overall CB/NT Site-wide risks. Waterway-specific risk estimates are presented to provide information on the possible extreme exposures and to help EPA put CB/NT Site-wide risks into perspective.

1.4.7 Although we do not dispute that more intensive fishing can be associated with Native American culture or subsistence factors, the cited studies are not relevant to Hylebos for the following reasons. Toy et al. (1994) is not site-specific. Site-specific data indicate that Native American fishing in the area is primarily focused on salmon, which are not caught productively in the Hylebos. Furthermore, since salmon spend little of their life in the waterways, the PCB concentrations in salmon would have little, if any, relationship to the PCB concentrations in the Hylebos. (17)

Response: First, whether or not subsistence fishing currently occurs at the CB/NT Site, it is a reasonable future use scenario and must be considered when evaluating residual risks present at the Site (see responses to Comments 1.4.1 and 1.4.2). While the Toy *et al.* (1996) study was not conducted for the tribes in the immediate area of the CB/NT Site, it was conducted for two tribes that each gather fish from the Puget Sound area. In this case, the collection of current site-specific data on fish consumption would reveal only current fish consumption rates and an approximation would still have to be used for the case of future exposure scenarios.

Additionally, while salmon may be the favored species, it is not the only species of fish caught from the CB/NT Site. English sole were evaluated in the risk assessment as a surrogate species to represent fish consumed from the CB/NT Site. Although salmon spend less time in the CB/NT area, they have a higher lipid content than English sole, and they tend to bioaccumulate PCBs at a higher rate. Therefore, despite the salmon's more transient residence in the CB/NT area, it is not certain that it will have accumulated significantly lower levels of PCBs from the CB/NT sediment than the English sole (see response to Comment 1.4.13).

Finally, although EPA used a reasonable maximum exposure scenario based on potential exposures to Native Americans, this scenario is also meant to be protective of subsistence fishers who are not Native American and who may be consuming fish other than salmon.

1.4.8 The report fails to address subsistence consumption. Much of EPA Region X's position to retain the previous risk assessment centered on protecting subsistence fishermen and their families. However, EPA did not use an ingestion rate representative of subsistence fishing in the ROD. (17, 29)

Response: The commentors are correct that the 1996 Weston report did not address subsistence fishing. The report has been revised to include residual risk estimates for Tribal fishers (one example of a population of subsistence fishers in the Commencement Bay area) (Weston, 1997a). See also the response to Comment 1.4.4.

1.4.9 Use of an industrial future use scenario for the Hylebos Waterway is consistent in spirit with the USEPA Memorandum entitled "Land Use in the CERCLA Remedy Selection Process," by Elliott Laws (1995) which calls for realistic future land use assumptions and recognizes industrial land use as a "reasonable assumption where a site is currently used for industrial purposes." (17)

Response: Elliott Laws' May 25, 1995, memorandum entitled "Land Use in the CERCLA Remedy Selection Process" states that EPA will use reasonably anticipated future use scenarios in developing remedial action objectives for Superfund cleanups. Seeking a way to apply this memorandum to the CB/NT Site, the commentor proposes that the Hylebos Waterway should be viewed like an industrial upland site. Comparing an upland to an aquatic site is inappropriate for several reasons, as discussed below.

First, EPA's mandate for protection of aquatic resources is entirely different than for protection of upland properties. The Clean Water Act sets forth a national goal for water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water (CWA §101[a]). The Clean Water Act, under Sections 302 and 303, also charges the States with responsibility for establishing water quality standards for all waters of the state, including designation of the uses for which a water body is to be protected. The Hylebos Waterway has been designated in Washington's Water Quality Standards (Chapter 173-201A WAC) as a Class B water body. Class B water bodies shall be protected for the following uses:

- water supply (industrial and agricultural),

- stock watering,
- fish and shellfish (salmonid migration, rearing and harvesting; other fish migration, rearing, spawning, and harvesting; clam, oyster, and mussel rearing and spawning),
- wildlife habitat,
- recreation (secondary contact recreation, sport fishing, boating, and aesthetic enjoyment), and
- commerce and navigation.

The State of Washington has also identified goals for marine sediments in the 1989 Puget Sound Water Quality Management Plan. This plan sets forth a conceptual sediment quality goal of the absence of acute or chronic adverse effects on biological resources or significant human health risk. This goal was incorporated into the Sediment Quality Objectives in the CB/NT ROD and subsequently led to the development of the State Sediment Management Standards.

The Hylebos Waterway serves several functions other than industrial use. Most importantly, it serves as habitat for a variety of marine organisms. The habitat functions of the CB/NT Site are a critical component of the CB/NT ROD and habitat considerations must be incorporated into CB/NT cleanup plans.

Second, EPA can take measures to restrict access and exposure to contaminants at an upland site, and can work with local zoning authorities to ensure that future land use will remain industrial. EPA cannot restrict access or exposure to contaminants at the Hylebos Waterway by marine organisms or humans. Recent development trends in the Hylebos Waterway, including construction of the Chinook Marina by the Puyallup Tribe (which is close to an area with high levels of PCBs), indicate that the public may have increased access to the Hylebos Waterway in the future.

1.4.10 The analysis of human health impacts from PCBs is inadequate to protect tribe members who consume large quantities of fish, crab, and shellfish. Consumption rates of shellfish should also be included with consumption rates of finfish species to reflect the total consumption rate of seafood from the study area. (29, 12)

Response: As indicated above, risks for tribal fishers (one example of a population of subsistence fishers in the Commencement Bay area) are presented in the Addendum (Weston, 1997a).

Consumption of crab and shellfish, grouped into the shellfish category, was considered in a previous risk assessment (Versar, 1985) conducted as part of the remedial investigation for the CB/NT Site. This risk assessment estimated the risks associated with contaminated shellfish to be approximately the same as the risks associated with eating contaminated finfish. In the risk assessment presented in the CB/NT ROD, consumption of English sole was used as a surrogate for consumption of other finfish and shellfish at the CB/NT site. It was determined in the ROD that an evaluation based on finfish consumption would be adequately protective of human health concerns related to seafood consumption from the CB/NT site. This assumption was also used in the reevaluation of residual risks associated with PCBs in the Addendum (Weston, 1997a).

1.4.11 Consumption rates need to address exposure rates of sensitive populations which may be consuming seafood from the Commencement Bay area. These populations are not well served by the moderate recreational seafood consumption rate of 12.3 grams per day. (12)

Response: EPA agrees. As discussed in responses to Comments 1.1.6 and 1.4.1, the risk evaluation presented in the Addendum (Weston, 1997a) was based on a revised set of exposure scenarios, including an upper-end tribal fishing scenario that was selected to better represent a reasonable maximum exposure to PCBs at the CB/NT Site. A consumption rate of 123 g/day, 69 percent of which was expected to come from the CB/NT Site, was used to represent a high-end tribal fisher.

1.4.12 There are no data to indicate whether shellfish bioaccumulate more PCBs than finfish and EPA's own risk assessments assumed the same level between the two. Thus, there will be no impact on the risk assessment results from considering shellfish. (17)

Response: As indicated in the response to Comment 1.4.10, shellfish consumption was not included in the risk assessment used to support the PCB SQO in the CB/NT ROD (EPA, 1989a), nor in the subsequent evaluations conducted for the reevaluation of the PCB cleanup level.

1.4.13 In using PCB concentrations in English sole to represent PCB concentrations in all fish, EPA assumes that the ingestion of fish is 100 percent English sole. Using PCB concentrations in English sole to evaluate PCB concentrations in salmon and other fishes is inappropriate. The Washington State Department of Health determined that English sole is not an accurate indicator of human health risks. English sole account for less than one percent of the fish consumed. Furthermore, EPA notes that using the predicted concentration of PCBs in English sole to represent the concentration of PCBs in all fish is conservative because: 1) English sole may not be representative of the majority of fish caught and eaten; and 2) English sole may bioaccumulate PCBs to a greater degree (a factor of 3 by EPA's own estimate) than the more typically eaten fish. EPA's report did not consider the site-specific data available that would portray a more realistic cross section of fish species consumed. (17)

Response: Each individual who consumes seafood from the CB/NT Site likely eats a slightly different type and number of the various types of seafood found in the area. To estimate the contaminant concentrations in seafood, EPA sampled and analyzed English sole, which occur in relatively large numbers in Commencement Bay. The use of surrogate or representative species, such as English sole, to represent the various types of seafood that might be eaten is a common practice in estimating risk from fish consumption at Superfund sites and other potentially contaminated areas.

English sole were chosen because they were cited in the remedial investigation report (Tetra Tech, 1985) as a conservative indicator of the contaminant levels that would be expected to occur in edible tissue of harvested fish species. This is in large part because they live in close association with the sediments and would be expected to accumulate contaminants from sediments. Recent reports by the Puget Sound Ambient Monitoring Program (PSAMP) on PCB concentrations in fish caught throughout Puget Sound also show that the average PCB concentrations found in English sole fillets are at the high end of the PCB concentrations found in most fish species in the Sound (O'Neill *et al.*, 1995). The PSAMP data also show that contaminant concentrations in English sole muscle tissue also correlate well with contaminant concentrations in nearby sediment samples.

Chinook and coho salmon had higher Puget Sound-wide average PCB concentrations than English sole, most likely due to their higher lipid content. Although salmon is an important food item for people in the Commencement Bay area, it was not considered to be a good species to use for the Superfund risk assessment because PCB concentrations in salmon tissue in general do not correlate well with site location, and salmon have a relatively short residence time at the CB/NT site. Therefore, EPA considers use of English sole as a surrogate species an appropriate approach for its reassessment of residual risks associated with PCBs in sediments.

1.4.14 The most important fish species consumed in the area (by weight) are salmon and squid - both of which do not spend considerable time in the Hylebos. (2)

Response: While these fish do not spend all of their time at the CB/NT Site, they do spend some of their time there. In that time, these fish are exposed to CB/NT contaminants, including PCBs. The risk estimates presented in the Evaluation of Residual Risks (Weston, 1996) and the Addendum (Weston, 1997a) accounted for consumption of all finfish, including salmon. Salmon, with their higher lipid content, (see response to Comment 1.4.13) likely accumulate some PCBs from the CB/NT Site even with a low residence time. Therefore, it is reasonable to consider consumption of these fish from the CB/NT vicinity as contributing to human health risks attributable to CB/NT contaminants.

1.4.15 It is not reasonable to assume that people consume fish livers from CB/NT fish on a regular basis. (22, 17)

Response: Although ingestion of fish livers was considered in the original CB/NT risk assessment, it was not a scenario retained in the risk evaluation supporting the PCB SQO presented in the 1989 ROD, nor was it considered in the Evaluation of Residual Risks (Weston, 1996) or the Addendum (Weston, 1997a).

1.4.16 EPA's PCB Report (Weston, 1996) does not clearly identify the population being assessed. As a result, a hybrid of assumptions are used that apply to no particular population. If cleanup decisions are to be based on risk assessment, site-specific exposure assumptions need to be used that account for the type and amount of fish actually consumed by the real population for a reasonable duration. While subsistence anglers might indeed consume more than the amounts listed in the EPA report, the anglers are not fishing in the Hylebos, they are not consuming English sole, and they are not consuming them for more than 30 years. By calculating one risk number for a "hybrid" exposure scenario, it is impossible to know who is being assessed in EPA's assessments. (17)

Response: The risk scenario that was established in the ROD (EPA, 1989a) and applied in the Evaluation of Residual Risks (Weston, 1996) was not a hybrid scenario; it comprised a recreational fisher who consumed average amounts of fish. The exposure assumptions used were consistent with site-specific information and risk assessment guidelines and policies available at the time. Residual risks presented in the Addendum (Weston, 1997a) were updated to reflect current EPA risk assessment guidelines (including the values applied to exposure duration), and were calculated for four different exposure scenarios (i.e., both average and high-end recreational and tribal fishers).

1.4.17 Current EPA policy, as articulated by EPA Administrator Carol Browner and others calls for risk assessments to present and discuss a range of values, to discuss the impact of parameter choices on the risk numbers, to discuss the populations being assessed, and to the extent possible, make reasonable assumptions for each population being assessed. (17)

Response: A range of parameter values and exposure scenarios was considered in the risk assessment presented in the ROD (EPA, 1989a). The Evaluation of Residual Risks (Weston, 1996) presented only one of the scenarios from the ROD (EPA, 1989a) because that scenario was used to calculate residual risks associated with the PCB cleanup level developed in the ROD. The uncertainty analysis presented in the Evaluation of Residual Risks (Weston, 1996) explored the impacts of different parameter choices on the residual risk estimates. Additionally, the Addendum (Weston, 1997a) presents residual risk estimates for four different exposure scenarios: average and high-end recreational fishers, and average and high-end tribal fishers. The high-end tribal fisher was chosen to represent the reasonable maximum exposure scenario; other risk estimates were provided to show the range of risks at the Site. As discussed in response to comments in Section 1.1, up-to-date parameters were applied to risk calculations for the Addendum (Weston, 1997a). Responses to previous comments in Section 1.4 discuss the reasonableness of parameter values and exposure scenarios evaluated in the risk evaluations (Weston, 1996, 1997a) conducted in support of the reevaluation of the PCB cleanup level.

1.4.18 The report fails to identify cumulative health impacts from a variety of chemicals, and fails to address impacts via a number of pathways. (29)

Response: See response to Comment 4.6.1.

1.5 Comments related to fish/sediment bioaccumulation data

1.5.1 Use of an empirical Biota-Sediment Accumulation Factor (BSAF) of 4.0 for English sole is inconsistent both with the site-specific results of 1.4 and with EPA risk assessment guidance. (17)

Response: EPA did not use a BSAF of 4.0 in any of the risk calculations for the CB/NT Site. The BSAF applied to risk calculations in the ROD, the Evaluation of Residual Risks (Weston, 1996) and the Addendum (Weston, 1997a) was 1.72, which is a site-specific value based on empirical data gathered from Commencement Bay. EPA believes that it is more appropriate to use this site-specific value rather than a literature-based value of 4.0 or the value of 1.4 calculated by Gradient Corporation (Gradient, 1995).

In 1995, Gradient Corporation calculated a site-specific BSAF of 1.4 based only on data from the Hylebos Waterway. The value of 1.4 was based on 1984 fish tissue data and 1994 sediment data. Gradient back-calculated PCB sediment concentrations using the BSAF of 1.72 and the calculated fish value. EPA does not believe Gradient's value of 1.4 is appropriate because: (1) it was calculated specifically for the Hylebos Waterway, while EPA believes it is more appropriate to assess risks to people fishing over the entire CB/NT Site, and (2) it is not appropriate to compare two data sets collected 10 years apart to calculate a BSAF. Also, as shown by Gradient's own calculations, the use of their BSAF would have very little impact on estimated PCB concentrations in fish and estimated residual risks after cleanup.

1.5.2 Prior to changing the existing cleanup level for PCBs, it would be beneficial to collect current fish tissue data and develop a more accurate sediment concentration-fish tissue concentration model. (34, 2)

Response: EPA agrees that it would be beneficial to collect current fish tissue data, but we believe that the environmental and economic costs of a six-month to one-year delay in the sediment cleanup process that would be associated with implementing such a program outweigh the benefits. EPA believes that the site-specific BSAF of 1.72 calculated for the CB/NT ROD (EPA, 1989a) provides adequate information about fish accumulation of PCBs from sediment and that application of this value to residual risk calculations provides adequate information for reevaluation of the PCB cleanup level for the CB/NT Site.

1.5.3 The Biota-Sediment Accumulation Factor (BASF) value of 1.72 should be rounded to 1.7. (12)

Response: The BSAF of 1.72 is the actual value used in the ROD (EPA, 1989a) as reported from site-specific studies. Rounding of this value to 1.7 would have minimal, if any, impact on calculated fish tissue concentrations and resulting residual risk estimates.

1.5.4 Identify what current science predicts to be the trigger level for bioaccumulation of PCBs. (8)

Response: There is no federal or state standard that sets a "trigger level" for bioaccumulation of PCBs, nor is there one PCB concentration that is commonly accepted in the scientific community as a threshold for bioaccumulative effects. The only PCB trigger level used in the Puget Sound area is the Puget Sound Dredged Disposal Analysis (PSDDA) program's PCB bioaccumulation trigger level of 38 mg/kg organic carbon (OC) (equivalent to approximately 900 μg/kg dry weight at the CB/NT Site). Dredgers with sediments containing 38 mg/kg OC must perform and pass bioaccumulation tests if they wish to dispose of their dredged sediments a the PSDDA open-water disposal site. Because there is no "trigger level" promulgated in federal or state laws for use in sediment cleanups, EPA must use site-specific evaluations such as the one contained in this Explanation of Significant Differences to determine an appropriate site-specific standard for PCBs that is protective of human health.

1.6 Comments related to ecological risks

1.6.1 The SQO should remain at 150 μg/kg total PCBs, based on the following natural resource information for sediment dwelling invertebrates and fishes. A Sediment Effects Concentration (SEC) of 303.8 μg/kg (dry weight at 1 percent organic carbon) identified by MacDonald (1994) represents concentrations of PCBs at which, more often than not, adverse biological effects were demonstrate in field studies. In a similar evaluation of a variety of data sets from marine and estuarine areas of North America, Long et al. (1995) calculated an Effects Range—Median (ER—M) of 180 μg/kg (dry weight at 1 percent organic carbon). This ER-M represented concentrations above which more than half of the reviewed studies indicated adverse biological effects. (24)

Response: EPA believes that it is more appropriate to set a PCB cleanup level based on a site-specific risk assessment, rather than relying on a database of studies which may or may not have relevance to the conditions at the CB/NT site. As noted in the January 1996 Eco Update (EPA, 1996b), PCBs are one of four chemicals or chemical groups that have a relatively low correlation between chemical concentration and effects level and thus have low accuracy with respect to predicting effects. Moreover, the PCB SQO of 300 μg/kg is equivalent to the sediment effects concentration of 303 μg/kg calculated by MacDonald (1994) and is actually fairly close to the revised ER-M (i.e., there are few points in the effects database separating the values of 180 and 300 μg/kg). The 300 μg/kg PCB SQO value falls within a range identified by Long *et al.* (1995) as a probable effects range.

1.6.2 U.S. Fish and Wildlife (FWS) has assembled a series of predictive models to illustrate the relationship between the PCB concentration in sediment and the PCB concentration that would result in the eggs of fish-eating birds (FWS, 1996a,b). These models are based on biota-sediment accumulation factors to determine the concentration in fish that would result from a given sediment concentration, and on biomagnification factors to translate this into an egg concentration. These models predict that a cleanup level of 30 μg/kg would be protective of a piscivorous bird since the predictive level of PCBs in the egg is generally below the lowest observable adverse effect level (LOAEL) for injury as determined by the Great Lakes data. However, at 150 μg/kg (the current SQO level for PCBs in the ROD), the predictive levels of PCBs in the bird egg increases and exceeds the injury threshold for the LOAEL. At 450 μg/kg the predicted concentration level of PCBs in the egg increases anywhere from 2 to 7 times higher than the threshold level. In addition, the model also illustrates the potential for greater impact to trophic levels higher in the food web, such as the federally listed peregrine falcon and bald eagle. (35)

Response: EPA appreciates the information provided in the U.S. Fish & Wildlife Service's (FWS's) letter regarding impacts of PCBs to birds, and has used it to the extent possible in its revised evaluation of residual risks (see Appendix A to the Weston Addendum [Weston, 1997a]). However, EPA modified the approach proposed by FWS, to make it consistent with EPA risk assessment policies and guidelines.

For example, FWS assumed in their analysis that fish and birds would be exposed only to the highest PCB concentration present in sediments after cleanup (450 μg/kg). EPA's view is that this approach tends to overestimate risks and believes it is more appropriate to evaluate risks to wildlife by using the average post-cleanup sediment PCB concentration (75 μg/kg Site-wide or 124 μg/kg in Hylebos Waterway). This assumes that the fish and birds feed in more than one location at the site or a waterway and are exposed to a range of PCB concentrations. Even in the case where piscivorous birds may exhibit a high degree of site fidelity, their prey are potentially exposed to contaminants over a broader area. Thus, average concentrations in sediment are an appropriate estimate for fish and bird exposure. In addition, use of an arithmetic average is protective because contaminants in sediment have a statistical distribution such that an average value tends to overestimate the true midpoint of the concentrations. EPA also believes that it is important to consider that PCB concentrations will be reduced over time through natural recovery.

In addition, the assumptions used to develop the biomagnification factors (BMFs) for eagles and peregrine falcons are highly conservative and assume that biomagnification is multiplicative between trophic levels. While the BMF for fish-eating birds was derived from empirical studies of herring gulls, the raptor BMF was extrapolated from other species. Currently, the FWS is conducting studies in the Columbia River to evaluate the health of bald eagle populations in this watershed. As part of this study, selected PCB congeners were measured in eagle eggs and several species. Data presented in an interim report (FWS, 1996c) suggest that the BMF may be within the same order of magnitude as calculated for the herring gull. (BMFs for selected congeners ranged from about 10 to 90. When weighted based on the fraction represented by the individual congener, the average BMF for both prey species combined was about 40, as opposed to 265 to 845 used in FWS's model. [This also assumes that 100 percent of their diet was derived from fish]).

In summary, EPA's analysis shows that cleanup to 450 μg/kg PCBs and subsequent natural recovery to at least 300 μg/kg PCBs is protective of fish-eating birds. EPA does not believe there is sufficient information at this time to assess risks to eagles and peregrine falcons.

1.6.3 It appears as though the proposed SQO value for PCBs is based on ecological endpoints rather than human health endpoints. (12)

Response: The PCB sediment cleanup level is based on protection of human health from ingestion of fish. Ecological endpoints were presented and discussed for comparative purposes because of the concern raised by reviewers that wildlife may be more sensitive to PCB sediment contamination than people.

1.6.4 The SQO should remain at 150 μg/kg total PCBs, based on the following natural resource information for sediment dwelling invertebrates and fishes. Further information that suggests concern over raising the SQO comes from the Hylebos Waterway fish injury studies currently being conducted by the National Marine Fisheries Service's Northwest Fisheries Science Center for the Natural Resource Trustees. This study shows that under current conditions concentrations of contaminants in juvenile chinook and chum salmon are comparable to levels previously shown to be associated with biological injury and nearly one third of adult English sole showed inhibited gonadal reproductive impairment, and up to half of juveniles displayed precocious sexual maturation. (24)

Response: The recent work by the National Marine Fisheries Service (NMFS) demonstrates that deleterious impacts to sediment-dwelling invertebrates and fishes are occurring under current conditions (i.e., pre-cleanup) and further emphasizes the need for cleanup to occur as quickly as possible. The NMFS report does not identify a protective PCB sediment cleanup level. Therefore, EPA relied on risk assessment methods to evaluate potential PCB cleanup levels for the CB/NT site.

2 <u>Comments Regarding Risk Management Issues</u>

2.1 Comments related to consideration of additional criteria to develop a PCB cleanup level

2.1.1 Explain why, if current Washington State Sediment Management Standards have already been used as a basis for cleanups at Eagle Harbor, Harbor Island and Ruston Way, *those same standards are not being applied to the Hylebos Waterway cleanup. We request that the EPA alter its course and accept the current Sediment Management Standards using reasonable assumptions and up-to-date science in setting cleanup criteria for Commencement Bay and the Hylebos Waterway. (15, 7)*

Response: The Washington State Sediment Management Standards (SMS) are not being used as an applicable, or relevant and appropriate requirement (ARAR) for the CB/NT Site because the SMS standards were promulgated after the CB/NT ROD was signed in 1989. After a ROD has been signed by EPA, the federal National Contingency Plan (NCP) (40 CFR Part 300) provides that a State or Federal environmental regulation is an ARAR only if it is necessary to ensure that the remedy is protective of human health and the environment.

EPA evaluated the Washington State SMS requirements and determined that application of the State SMS requirements was not necessary to ensure protectiveness. In addition, it was not more stringent than the evaluation process EPA used to select a PCB cleanup level. EPA's CB/NT PCB SQO of 300 μg/kg and sediment remedial action level (SRAL) of 450 μg/kg fall within the range of numeric PCB standards which have been set under the SMS to protect aquatic life (equivalent to 130 μg/kg dry weight to 1,000 μg/kg dry weight). Although the State SMS contains a narrative human health standard, the State has not yet set a numeric standard for PCB concentrations in sediments for protection of human health. Therefore, EPA has determined that it is not necessary to consider the State SMS an ARAR to ensure the protectiveness of the remedy.

2.1.2 Review of all EPA RODs nationwide involving PCBs reveals that the Commencement Bay ROD PCB criterion of 150 μg/kg is among the lowest in the nation. Out of 53 sites nationwide, the Hylebos is held to the lowest range of PCB criteria; for similar Superfund sites, Commencement Bay ROD PCB criteria of 150 μg/kg are also the lowest. RODs for comparable sites provide for a more realistic PCB cleanup criterion of 1,000 μg/kg, even without consideration of the 1996 update of the PCB cancer slope factor. (17)

Response: Cleanup levels presented in Superfund RODs are site-specific and should not be taken out of context from the other information presented in the ROD. Although EPA strives for national consistency on the process used for determining cleanup levels for Superfund sites, site-specific circumstances often lead to selection of different cleanup standards. Some of the PCB cleanup levels at other Superfund sites may be higher than at the CB/NT Site for several reasons: (1) different exposure scenarios may be of concern at those sites, or (2) technological or feasibility issues may limit the possible extent of cleanup.

One of the things that makes the CB/NT Site different than many other Superfund sites is the relatively high potential for exposure to site contaminants by humans and wildlife. The CB/NT Site is part of the usual and accustomed fishing grounds of the

Puyallup Tribe. It is therefore important that the cleanup level take into account protection of Tribal consumers of fish, who generally consume more fish than recreational fishermen. Protection of wildlife must also be considered. The CB/NT area is used for foraging by shorebirds and other wildlife. Consideration of these factors may lead to selection of a lower sediment PCB cleanup level at the CB/NT Site than at other Superfund sites.

In addition, cleanup at several Superfund sites with PCB contamination in sediments is limited by practical constraints that are not present at the CB/NT Site. For example, at many areas in the East Coast and Great Lakes, PCB contamination is so widespread that 1,000 μg/kg is the lowest practical PCB cleanup level that can be achieved. At some sites, PCB concentrations are so high (thousands of parts per million [ppm]) that extensive engineering controls are necessary to control migration of PCBs into the water and air during dredging. Because the highest PCB concentrations at the CB/NT Site are on the order of 25 mg/kg, potential releases of PCBs during dredging can be controlled much more easily.

2.1.3 EPA should draw on other information such as cost-benefit evaluations to support the selection of a realistic cleanup level for PCBs that will allow for the cleanup to get started. (17)

Response: EPA considers cost-effectiveness as one of the nine evaluation criteria used to make Superfund cleanup decisions.

2.1.4 EPA Region X should increase the cleanup goal for PCBs in sediments on the Hylebos Waterway from the current SQO to 150 μg/kg, dry weight to at least 600 μg/kg, dry weight. This change will decrease the cost of cleanup by approximately 35 million dollars based on volumes and cost presented in Tables ES-1 of the Evaluation of Residual Risks (Weston, 1996), while causing an insignificant increase in the potential risk to a very limited, hypothetical population. Using the numbers from your own report, the risk to a potential fisherman who spends his whole lifetime eating bottom fish daily from Commencement Bay would increase from a 5.3 chance in 100,000 to a 7.3 chance in 100,000 of contracting cancer (Table 3.4 of the Evaluation of Residual Risks.) (14)

Response: EPA considered each of the nine evaluation criteria, including cost, in its reevaluation of the PCB cleanup level for the CB/NT Site. See responses to comments in Section 3.2 for discussion of particular cleanup levels.

2.2 Other Comments

2.2.1 Have the sources of PCB contamination been eliminated? (8)

Response: PCBs have not been manufactured since 1977. Although surplus stocks of PCBs were allowed to be used in the short-term, PCBs have been replaced in all their applications over the last 20 years. Even so, PCBs may be present at facilities in the CB/NT area if, for example, PCB-containing materials were spilled or buried in the ground.

In order to control ongoing sources of contamination to the CB/NT Site, the Washington State Department of Ecology (Ecology) has inspected or investigated virtually every industry in the Commencement Bay tideflats area. They have identified facilities they believe to be ongoing sources of contamination to the CB/NT Superfund Site, and have initiated cleanups, required permits or required implementation of best management practices to control pollution at most of them. PCBs have been found in upland soils at a few facilities, primarily along the Hylebos Waterway. Ecology has required cleanups at these facilities. Ecology hopes to complete all necessary source control activities by 1998. See response to Comment 5.4.1 for further discussion of source control activities at the CB/NT Site.

2.2.2 To address questions regarding the risk evaluation and reevaluation of the SQO for PCBs, CHB recommends putting together a discussion forum....A neutral facilitator should moderate the discussion. (8)

Response: Subsequent to receipt of this letter, EPA and Citizens for a Healthy Bay (CHB) discussed the possibility of a discussion forum with several potential participants. EPA and CHB decided that there was not sufficient interest among potential participants to hold a discussion forum. Instead, EPA initiated several activities to solicit public input and to keep the public informed about the PCB reevaluation. These efforts are described in the introduction to this responsiveness summary.

2.2.3 This evaluation is incomplete because it analyzes potential recommendation scenarios as if PCBs were the only contaminant of concern in Commencement Bay. (24)

Response: As stated in the CB/NT ROD, PCBs were the only contaminant of concern at the CB/NT Site for which ecological cleanup goals would not be sufficiently protective of human health. For this reason, PCBs have been segregated from other contaminants of concern. (See Section 7.1 of the CB/NT ROD, where discussion of human health risks is presented.) Further discussion of this issue is presented in response to comments in Section 4.6.

2.2.4 The PCB SQO was established by a human health risk assessment, which was thought to be a more sensitive endpoint than an ecological endpoint at the time of the Record of Decision. While the dose response curve for human cancer posed by PCB's cancer risk posed by PCB to humans may be lower than previously thought, new studies are showing greater effects to fish and wildlife than was previously known. (24)

Response: EPA agrees that it would be beneficial to check the assumption in the ROD that a PCB sediment cleanup level based on human health would also protect wildlife. An evaluation of the threats to wildlife from exposure to contaminated prey or sediment was performed by EPA as part of the Addendum (Weston, 1997a). The results were used to ensure that the selection of a PCB cleanup level based on protection of human health would also be protective of wildlife.

2.2.5 It has recently been discovered that the toxicity of PCBs is not related to the degree of chlorination. (17)

Response: EPA disagrees. In the support document that summarizes the calculation of the new cancer slope factors for PCBs (EPA, 1996a), different slope factors are to be used depending on both route of exposure and percent of chlorination. For example, the lowest upper-bound slope factor of 0.07 per mg/kg-day is to be used only when analyses verify that congeners with more than four chlorines comprise less than 1/2 percent of total PCBs. Route of exposure is considered because of the expected partitioning of more highly chlorinated congeners in certain media (e.g., fish, sediment, soils). As recommended by this document, the highest slope factor of 2.0 was used in the Addendum (Weston, 1997a) since the route of exposure assumed for all exposure scenarios was fish consumption.

2.2.6 The Puyallup Tribe of Indians has not been recognized as a sovereign Indian nation with governmental and proprietary interests in this matter, not limited to its treaty resources, which have been seriously impacted by the release of hazardous substances including PCBs into Commencement Bay. EPA's risk assessment fails to acknowledge the well documented tribe's concerns; does not meet the legal requirements that provide for permanent cleanup of the Hylebos Waterway; ignores EPA's obligations under its Environmental Justice mandate and the protection of human health and the environment as demanded by Superfund. (29)

Response: EPA agrees that the Evaluation of Residual Risks (Weston, 1996) did not fully address some of the Tribe's concerns. EPA's Environmental Justice guidelines require consideration of populations who may have disproportionately higher exposures to contaminants in Superfund risk assessments and in Superfund cleanup decisions. For these reasons, and because EPA believes it represents a realistic future use scenario for the site, EPA updated the human health risk assessment in the Addendum (Weston, 1997a) to evaluate residual risks after cleanup using high-end tribal fishing as the reasonable maximum exposure scenario.

As to legal requirements for permanent cleanup, the Superfund law does state a preference for treatment to permanently and significantly reduce the volume, toxicity, and mobility of hazardous substances, pollutants, and contaminants. However, EPA determined in the 1989 CB/NT ROD that the nature of the contamination at the CB/NT site (i.e., widespread, low-level contamination) limits the feasibility of treatment options. Confinement was therefore selected as the appropriate remedial action for

CB/NT sediments with higher contaminant concentrations, and natural recovery for sediments with moderate to low contaminant concentrations. EPA's reevaluation of the PCB cleanup level does not change this fundamental aspect of the remedy EPA selected in 1989.

Part II—Responses to Comments Received Subsequent to Issuance of the Draft ESD

NOTE: These comments relate primarily to two documents: the Public Review Draft Explanation of Significant Differences (EPA, 1997a), and the Addendum to the Evaluation of Residual Risks (Weston, 1997a), which included an ecological evaluation as an appendix.

3 Comments Related to the Proposed PCB Cleanup Level

3.1 Comments in support of the proposed PCB cleanup level

3.1.1 We support the EPA's proposal to modify the PCB cleanup level from 150 μg/kg to be achieved within ten years to 450 μg/kg to be achieved immediately after cleanup. (5, 10, 19, 22, 23, 20)

Response: Comment acknowledged.

3.1.2 While we believe that the 450 μg/kg level proposed by EPA is significantly below PCB cleanup standards set at other sediment Superfund sites, the level is more realistic and reflective of current science than the 150 μg/kg level contained in the 1989 Record of Decision. We also believe that any level lower than 450 μg/kg would seriously compromise the ability of the parties at the various waterways to take advantage of combined disposal opportunities. The volume of sediment which may have to be removed from the larger waterways in order to meet an unrealistic level of 150 μg/kg could far exceed the available capacity at the various disposal sites currently being considered by the parties in conjunction with the Sediment Disposal Site Forum, thus eliminating the possibility of a combined disposal site and/or necessitating additional sites to accommodate excess volumes. (23)

Response: Foremost among all considerations in making a cleanup decision, EPA focused on establishing a PCB cleanup level that would be protective of human health and the environment. As discussed in response to comments in Section 5.2, EPA establishes cleanup levels on a site-specific basis. As discussed in the ESD, in assessing the implementability, short-term effectiveness, and cost of various alternative cleanup levels, EPA considered the volumes of sediment to be removed to achieve the potential cleanup levels. EPA also considered the disposal options associated with containing these volumes of sediment in its reevaluation of PCB cleanup levels at the CB/NT Site.

3.2 Comments recommending a higher PCB cleanup level

3.2.1 The 150 μg/kg PCB number should be modified to be consistent with all other similar Superfund sediment sites—recent PCB cleanup standards have been set at 1,000 μg/kg. The 450 μg/kg PCB cleanup standard would be the most rigorous cleanup standard ever required of any similar Superfund site in the U.S. Even at 600 μg/kg, the standard would be the toughest in the nation for such sites. (6, 18)

> **Response**: As discussed in response to Comment 2.1.2, EPA's cleanup decisions are made on a site-specific basis and must be protective of human health and the environment at the given site. EPA selected the 450 μg/kg PCB cleanup standard because it is protective of human health and the environment, and provides the best balance of cost, long-term effectiveness and short-term effectiveness. Cleaning up to 600 μg/kg PCBs or higher will be less protective of human health and the environment, will provide less long-term effectiveness, and will result in only a small decrease in the cost of the cleanup. For further discussion, see response to comment 3.2.2.

3.2.2 The human health risk estimates based on a PCB cleanup level of 600 μg/kg range from 2.75 x 10^{-5} to 2.1 x 10^{-4} (Weston, 1997a). Table 2 in the Addendum (Weston, 1997a) shows that there is little difference in the 450 μg/kg and 600 μg/kg cleanup levels based on residual risk estimates. EPA's explanation for the acceptability of 450 μg/kg as a cleanup level (Weston, 1997a, p.11) also applies to higher cleanup levels provided that the residual risks do not substantially exceed 1 x 10^{-4}. The highest estimated residual risk (High-End Recreational Fisher), based on a PCBs cleanup level of 600 μg/kg, is 2.1 x 10^{-4}. This estimated residual risk is not substantially greater than 1 x 10^{-4}. Given EPA's rationale for the acceptability of 450 μg/kg, a PCBs cleanup level of 600 μg/kg would cut down on cost from the proposed 450 μg/kg cleanup level, and would still meet the criterion for protectiveness. (1, 6, 18, 9, 17, 19, 23, 25, 30, 13, 17)

> **Response**: Because EPA assumes that there is no threshold below which carcinogenic effects of PCBs will not occur, EPA strives to minimize this risk to the extent possible. In selecting the 450 μg/kg PCB SRAL, EPA considered other potential cleanup levels, including a 600 μg/kg cleanup level. Potential cleanup levels from 300 μg/kg to 600 μg/kg cleanup level fall at the high end of a range of values which EPA considers protective of human health and the environment, based on a tribal fishing scenario, and which offer similar benefits in protectiveness.
>
> EPA's goal in the Superfund program is to select remedies which reduce human health cancer risks associated with exposure to site contaminants to 10^{-4} to 10^{-6} or below. EPA chooses cleanup levels that will achieve reduction of risks to within this range, accounting for the uncertainties associated with calculated risk estimates. EPA selected the 450 μg/kg PCB SRAL because it is protective of human health and the environment, and provides the best balance of cost, long-term effectiveness and short-term effectiveness. Because the cost difference between the 450 μg/kg cleanup level and the 300 μg/kg cleanup level is very large (about $13 million, a 72 percent increase in cost), EPA determined that the small environmental benefits to be achieved by going

to the lower cleanup level were outweighed by the cost. However, EPA has added a requirement that PCB concentrations be reduced to 300 μg/kg within 10 years of completion of the remedy. Adding the 300 μg/kg PCB SQO provides additional protectiveness and adds only a small cost to the remedy (for natural recovery modeling and monitoring, and potentially for additional remedial action if models have incorrectly predicted natural recovery rates).

EPA also considered whether a 600 μg/kg cleanup level was appropriate. The cost difference between achieving a 450 μg/kg cleanup level versus a 600 μg/kg cleanup level is about $2.5 million, or a 16 percent increase in the cost of the Hylebos Waterway cleanup. EPA determined that, as with the 300 μg/kg SQO, the relatively small increase in cost was justified to achieve an incremental increase in environmental benefit, especially considering the uncertainties associated with estimates of the toxicity of PCBs (see response to Comment 4.3.3).

3.2.3 Reducing the volume to be dredged not only is more cost effective, but also is less disruptive to existing aquatic life. Also, this reduces the volume of the disposal site material which must be managed long term. Therefore, since both the 450 μg/kg and the 600 μg/kg cleanup levels are protective of human health and the environment, 600 μg/kg is a better choice. (9)

Response: As part of its reevaluation of the PCB cleanup level, EPA considered cost, short-term effectiveness, and long-term effectiveness. Under the short-term effectiveness criterion, EPA considered the potential detrimental effects to aquatic life associated with cleanup to a range of different potential cleanup levels. EPA concluded that cleanup of sediments to 450 μg/kg provides sufficient additional protectiveness and long-term effectiveness over cleanup to 600 μg/kg to justify a small increase in cost and disruption to aquatic life during dredging.

3.2.4 There is a tremendous cost savings if the cleanup level is set at 450 to 600 μg/kg because there will be a reduction in the volume of sediment that must be remediated. While cost savings alone should not determine human health risks, where the scientific data supports a modification which will result in a savings of millions of dollars, we believe a compelling case is made for the modification. In fact, the arithmetic mean baywide residual concentration of PCBs, following a 600 μg/kg cleanup, is 82 μg/kg compared to 75 μg/kg for a PCB cleanup of 450 μg/kg, an insignificant difference. That's only a seven part per billion change in PCB concentration for a cost of about 3 million dollars. (19, 17, 18)

Response: EPA considered the difference in cleanup volumes necessary to achieve each of the potential PCB cleanup levels in its reevaluation. As discussed in response to Comment 3.2.2, EPA considered the costs and benefits of selecting a 450 μg/kg versus a 600 μg/kg PCB cleanup level for the CB/NT site and determined that 450 μg/kg offered better protection of human health and the environment with only a small incremental increase in cost.

3.2.5 The difference in residual PCB sediment concentrations between cleaning up to 450 μg/kg and cleanup up to 1,000 μg/kg is insignificant, 1,000 μg/kg is a protective level, and it would be more cost-effective to cleanup to 1,000 μg/kg. (6, 18, 7, 27)

Response: While EPA did not include a potential 1,000 μg/kg PCB cleanup level in its analysis, EPA did consider a 900 μg/kg PCB cleanup level, which would give roughly similar results as a 1,000 μg/kg cleanup level. Because there are few areas of Hylebos Waterway sediments contaminated with PCBs at concentrations between 450 and 900 μg/kg, the cost difference to go from a 450 to a 900 μg/kg PCB cleanup level is not large, about $4 million. This represents a 29 percent cost increase to achieve a 450 μg/kg cleanup level as opposed to a 900 μg/kg cleanup level. EPA determined that in this case the relatively small increase in cost was justified to achieve an incremental increase in environmental benefit, especially considering the uncertainties associated with risk estimates for PCBs. See EPA's response to Comment 3.2.2 for further discussion.

3.3 Comments recommending a lower PCB cleanup level

3.3.1 The proposed 450 μg/kg cleanup level overprioritizes cost issues and would not be protective of human health and the environment. (28, 11, 29, 35, 36, 9, 9)

Response: EPA is required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; Superfund) to select remedies for Superfund cleanups that are protective of human health and the environment. EPA must also select cost-effective response actions for Superfund cleanups. A remedial alternative is considered "cost-effective" if its costs are proportional to its overall effectiveness. Overall effectiveness is determined by evaluating its short- and long-term effectiveness. In this case, the alternative PCB cleanup levels evaluated showed only a small difference in short-term and long-term effectiveness and environmental benefit, but a large difference in cost. Therefore, cost became a significant factor in EPA's decision. EPA believes that its decision to require a 450 μg/kg SRAL, to be achieved at the time of dredging, and a 300 μg/kg SQO, to be achieved within 10 years of completion of the cleanup, is protective of human health and the environment, and meets the CERCLA criterion for cost-effectiveness.

3.3.2 EPA should be more protective, not less protective, of human health and the environment, and therefore, should not raise the cleanup level. (9)

Response: EPA agrees that it should be as protective as possible in selecting cleanup levels for Superfund response actions. However, EPA is also required under CERCLA to select cost-effective cleanups, and to ensure that significant environmental protection is achieved for every dollar spent for cleanup. In this case, new information since the 1989 ROD indicates that remediation to the original cleanup level will involve a substantially larger amount of sediments than originally anticipated, along with significantly increased costs. In addition, new information about the risks associated with PCBs prompted EPA to reevaluate the original PCB cleanup level. After considering this new information, EPA determined that remediation to an alternative cleanup level would be considerably less expensive, with only a small increase in risk when compared to the cleanup level in the 1989 ROD. The new cleanup levels are, however, still within EPA's acceptable risk range for Superfund cleanups.

3.3.3 EPA should cleanup PCBs in Commencement Bay sediment to the area background PCB sediment level. (9)

Response: CERCLA requires that Superfund cleanups be protective of human health and the environment. In some circumstances, it is necessary to achieve background concentrations to be protective. In this case, EPA believes protectiveness can be achieved at concentrations above background. Estimates of area background PCB concentrations in sediments range from 20 to 50 μg/kg in Puget Sound. The average PCB concentration in CB/NT sediments after cleanup will be 75 μg/kg immediately after cleanup and will be reduced to 63 μg/kg or lower within 10 years after the cleanup. PCB concentrations at the CB/NT site will be somewhat higher than background after cleanup, but will still be protective.

3.3.4 EPA's Fact Sheet states that the proposed change in the PCB cleanup levels would have a <u>significant effect</u> only in the Hylebos Waterway cleanup. The Hylebos Waterway completes the drainage for Hylebos Creek, which connects the Bay with sensitive wetlands and uplands throughout the watershed. As such the Hylebos Waterway should be treated with greater concern than the transportation channels formed by other waterways, not sacrificed to the "average" health of the Bay. (28)

Response: EPA agrees that the ecological health of the Hylebos Waterway should be preserved and protected. By stating that the proposed change in the PCB cleanup level would have a significant effect only on the Hylebos Waterway, EPA meant that it focused the cost analysis on the Hylebos Waterway, because the PCB cleanup level has little effect on the cost of cleanup of other Commencement Bay waterways. EPA's risk analysis focused on CB/NT Site as a whole, because EPA felt it was reasonable to assume that most fish, birds, and humans would utilize more than one area of the Site. However, EPA includes in its analysis an assessment of the risks to humans and wildlife that reside or consume fish only from Hylebos Waterway, to ensure that by selecting a cleanup level that was protecting the Site as a whole, a cleanup level was not selected that would have a disproportionately large impact to individuals who preferentially utilize the Hylebos Waterway.

4 Comments Related to the Risk Evaluations

4.1 Comments relating to the residual PCB sediment concentration

4.1.1 Since dredging for cleanup would likely reach native sediments, using the background value as the replacement value in the calculation of residual sediment concentrations is likely an overestimate because native sediments should have a PCB concentration of zero. It would be more appropriate to use zero, or half the PCB detection limit, or even the PCB detection limit as the replacement value. (9)

Response: Because PCBs have been in use for so long, and because they are so pervasive in the environment, native sediment PCB concentrations at the CB/NT Site are not expected to be zero. EPA used a 20 μg/kg PCB concentration for native sediments, which is reflective of background concentrations in areas with no local sources of PCBs. It is also in the range of method detection limits for PCBs in sediments (20 to 40 μg/kg) under the analytical methods used for pre-design sampling.

4.1.2 The use of the arithmetic mean simply because it is EPA policy is not appropriate if the distribution of PCB concentrations is lognormal. Furthermore, using the arithmetic mean PCB concentration to account for the fact that the more contaminated sediments tend to be located nearshore in the shallow subtidal and intertidal areas where many fish species or life stages tend to be during flood tides, is flawed. If this is where the most contaminated sediments are located, then this is where the remediation will occur. Therefore, the residual concentrations in this area should be 0 (zero), or at least background. The remaining concentrations will still be lognormally distributed and therefore it is appropriate to use a geometric mean as the basis of the residual concentration. (Whether you use the geometric mean or upper 90 or 95 percentile of the geometric mean is another issue.) (1, 9)

Response: The arithmetic mean was chosen to represent residual sediment concentrations because it was consistent with current EPA policy and because it was thought to be appropriately protective. EPA guidance (EPA, 1992) states that the arithmetic mean is appropriate because it best represents the cumulative intake that would result from long-term contact with site contaminants regardless of the pattern of daily exposures over time or the type of statistical distribution that might best describe the sampling data. In fact, EPA guidance recommends that the 95 percent upper confidence limit of the arithmetic mean be used in risk assessments, because in most environmental sampling, the sample size is too small to accurately reflect the central tendency of the data. In this case, because of the large sample size (over 200 samples for the Hylebos Waterway and over 400 samples for the CB/NT Site as a whole), EPA determined that an arithmetic mean, rather than a 95 percent upper confidence level, is an appropriate concentration term to use in the residual risk assessment.

At the CB/NT Site, while the distribution of PCBs within the sediment of individual waterways tends to form a lognormal distribution, as noted by the commentor, sediments with higher PCB concentrations tend to be located along the banks of the waterways where the fish are likely to spend a disproportionate amount of time. For this reason, the arithmetic mean was chosen as a more protective value. While it is true that the more contaminated sediment will be remediated, sediments with PCB concentrations below the selected cleanup level will remain after cleanup. Because there are relatively higher concentrations of PCBs in the bank areas, residual PCB concentrations after cleanup will be somewhat higher nearer to the banks and in habitat in which the fish may spend more time. Therefore, use of the geometric mean may underestimate actual PCB concentrations to which fish may be exposed. See also EPA's response to Comment 1.2.2.

4.1.3 It is not clear why EPA sometimes averages residual PCB sediment concentrations based on waterways and sometimes across the entire bay. (8)

Response: Risks were calculated for the overall CB/NT Site and for two individual waterways: the Hylebos and the Thea Foss waterways. While EPA did consider both the CB/NT-wide and the waterway-specific residual risk estimates in its reevaluation of the PCB cleanup level for the CB/NT Site, the CB/NT-wide estimates were used as the primary factor in making risk-based decisions.

4.1.4 Risks are not associated only with average PCB sediment concentrations, but also with concentrated "hot spots" throughout the bay. Averaging residual sediment concentrations underestimates the impact of localized or hot spot exposures. Exposure point concentrations should not be averaged on a bay-wide or even waterway-wide basis. There is preferential use of habitat and varying site fidelity among species. Averaging residual sediment concentrations underestimates the potential for adverse impacts to fish and wildlife species that exhibit some degree of site fidelity in feeding behavior. *(35, 28, 8, 24)*

Response: Risks were evaluated for potential exposures following sediment cleanup, not for current conditions. The purpose of the cleanup is to remove PCB "hot spots." After the hot spot cleanup, the remaining PCBs will be at lower concentrations and more evenly distributed in the bay. For this and the reasons discussed in responses to Comments 1.2.2 and 4.1.2, a representative average PCB sediment concentration is appropriate for estimating concentrations of PCBs in fish to which people will be exposed after cleanup. While some fish may be exposed to higher concentrations of PCBs, other fish may be exposed to lower concentrations. Furthermore, fish are mobile, and are exposed to varying concentrations of PCBs as they move throughout or within different areas of the waterways.

The arithmetic mean is also an appropriate representation of residual sediment concentrations with respect to evaluating risks from ecological exposures. In ecological risk assessments, risks to populations and communities of receptors are evaluated, not risks to individual receptors (except in the case of threatened or endangered species). Therefore, while some fish may be exposed to slightly higher concentrations of PCBs due to habitat or site fidelity, other fish will be exposed to lower than average concentrations. As stated above, the arithmetic mean was chosen over the geometric mean to ensure protectiveness while allowing for the possibility that fish might be exposed to elevated concentrations. The arithmetic mean is also appropriate for higher order receptors (e.g., fish-eating birds) for the same reasons that apply to it being protective of human health.

Furthermore, EPA does not believe that using a maximum single-point measurement (as represented by a grab sample) is appropriate to evaluate the risks to wildlife, because very few species (with the exception of sessile benthos) will feed repeatedly at a single point. Most species that exhibit a high degree of site fidelity prey on species that feed over an area.

4.1.5 The averaging of the cleanup levels in sediment should take into account habitat-specific or habitat-weighted assessment in deriving a protective sediment concentration. (24)

Response: Area-weighting by habitat type is an approach that could be used to calculate residual PCB sediment concentrations. The highest sediment PCB concentrations tend to occur in the intertidal banks and shallow nearshore areas because of proximity to source and sediment transport mechanisms. These areas are also most often used by sensitive taxa or life stages of species of concern. Most of these areas with elevated concentrations are already identified as requiring remediation in both the Thea Foss and Hylebos waterways. The remaining concentration of PCBs has been represented in the reevaluation of risks by the arithmetic mean, which tends to overestimate the actual concentration of these chemicals and is thus conservative with respect to protection of natural resources. See also EPA's response to Comments 1.2.2 and 4.1.2.

4.1.6 The average sediment PCB concentrations used in the risk calculations over-predict the post-cleanup concentration of PCBs because cleanup of other chemicals will remove additional PCBs (below the target cleanup level) from the Hylebos Waterway. In addition, ongoing natural recovery will further reduce the PCB concentration in sediment. (17)

Response: EPA agrees that cleanup for other chemicals and natural recovery will reduce contaminant concentrations beyond the averages presented in the 1997 Weston report. In the final decision, EPA has incorporated natural recovery by adding a 10-year PCB SQO of 300 μg/kg. EPA agrees that there will be additional reductions of PCB concentrations through incidental cleanup of PCBs present in cleanup areas for other chemicals. This factor was not included in the 1997 Weston risk assessment because it cannot be quantified until cleanup areas for other chemicals are finalized. Omitting this factor from the quantitative analysis adds an element of conservatism in the calculation of residual risks, which EPA believes is appropriate.

4.1.7 How can EPA use a "background" concentration of 30 μg/kg PCBs in this process? PCBs are man-made compounds. By definition, there is not a natural background concentration for PCBs and an area background of 30 μg/kg for (southern?) Puget Sound is outrageous! (It is unclear what region of the Sound this background level is defined for since Commencement Bay is in the Central Basin and Carr Inlet, whereas the "background" samples were collected south of the Narrows and therefore in South Sound.) By accepting a background concentration this high it appears that a risk to human health of approximately 10^{-5} exists in Puget Sound from PCBs alone! Is this acceptable to EPA? Is EPA planning to remediate the background sample collection site at Carr Inlet or the entire Puget Sound? Please explain the logic that went into accepting this background concentration for PCBs. (9)

Response: While PCBs do not naturally occur in the environment, they are widely distributed throughout world, including Puget Sound. PCBs are no longer produced in the United States, but they are persistent chemicals that have built up in the environment over time. PCBs are widely distributed because of sediment and airborne transport. For this reason, PCBs often appear in non-industrial areas without a direct point source of contamination. These PCBs form what is referred to as "background concentrations." EPA used background concentrations as a basis for comparison to potential PCB concentrations after cleanup, and did not base its cleanup levels on background.

4.1.8 For what surficial area and depth of sediment are the arithmetic means in Tables 4, 5, and A-1 representative? (1)

Response: The arithmetic means presented in the Addendum (Weston, 1997a) and the ESD (EPA, 1997a) are based on the surface areas of the entire Hylebos Waterway, the entire Thea Foss/Wheeler-Osgood waterways, and the overall CB/NT Site, which includes all waterways and the adjacent area of Commencement Bay out to the 60-foot bathymetric contour. (See Figure 1 in the ESD.) Surface samples represent depths up to 0.3 foot. Surface sample concentrations will be used to evaluate the need for remediation of a given area. Remediation depths are anticipated to be determined by the depth to reach native sediment. Based on existing data, this depth is anticipated to average approximately 7 feet in the Hylebos and roughly 6 feet in the Thea Foss Waterway. (See also response to Comment 4.1.10.)

4.1.9 Is not the great majority of the PCB exposure to fish from the surface (top layer) of the sediments and the resident benthic organisms? If yes, what is the purpose of targeting the cleanup level "at all points," i.e., at all depths? (1)

Response: EPA agrees that the primary exposure to contaminated sediments by aquatic organisms occurs at the surface layer. Cleanup decisions will be based on PCB concentrations in surface sediment, not concentrations at all depths. At the CB/NT Site, it has been found that contaminants generally reside in the unconsolidated sediments which lie above the native sediments (i.e., sediments which have accumulated since the waterway was last dredged), and that native sediments contain only low concentrations of contaminants. Therefore, dredging depths were determined based on the depths necessary to reach native sediment. Average residual PCB sediment concentrations were calculated from surface PCB sediment concentrations expected to remain at each sampling station after cleanup.

4.1.10 What PCB Aroclors are present? Nowhere in the ROD or ESD are PCB Aroclors identified. (1)

Response: The most prevalent aroclors present at the CB/NT Site are Aroclor 1254 and Aroclor 1260. Aroclor 1242 was also detected.

4.1.11 Many of the people who fish and harvest in the bay consume greater than average quantities of fish and shellfish than the general population. Therefore, use of average residual sediment concentrations may underestimate the exposure to PCBs from the bay. (35, 28, 8)

Response: EPA acknowledges that some individuals who fish at the CB/NT Site consume greater than average amounts of fish. Therefore, EPA is using a high-end tribal fishing scenario for decision-making purposes. Residual sediment concentration is only one parameter used to calculate residual risks. Examples of other parameters include the amount of fish consumed, the fraction of fish consumed that comes from the CB/NT area, and the duration of exposure. As discussed in response to Comment 4.2.2, EPA develops a reasonable maximum exposure scenarios for Superfund risk assessments as a mix of average and upper end parameter values that best represents some of the most highly exposed individuals at the Site. For this reason, EPA felt that use of an average residual sediment concentration was appropriate and protective. (Also, see responses to Comments 1.2.2 and 4.1.2.)

4.2 Comments Relating to human exposure factors

4.2.1 Subsistence fishing is a main source of food for many residents in the area and can be witnessed on any weekend at the floating dock in the Thea Foss Waterway. Many of the fishing community are low income and rely on fish and shellfish for a substantial part of their diet. Those for whom subsistence fishing is a main source of food are much more vulnerable. (3, 8).

Response: EPA recognizes that fish from the CB/NT Site may currently or in the future provide a substantial part of some individuals' diets, even though local health authorities have posted signs warning against consumption of fish from the CB/NT Site. EPA has no information on the number of subsistence fishers currently utilizing the CB/NT Site or on their fish consumption rates. Instead, EPA used information from recent studies (Toy et al., 1996) of fish consumption by Puget Sound Native American tribes to develop a "high-end tribal fisher" (i.e., a tribal fisher who consumes a higher than average amount of fish) fish consumption rate of 123 grams/day. EPA believes that in the absence of subsistence fishing data, the high-end tribal fisher estimate provides a reasonable representation of the type of consumption rates that might be seen in a subsistence population. For this reason, the fish consumption exposure scenario has formed the basis of EPA's PCB risk reevaluations for the CB/NT Site. In the Addendum (Weston, 1997a), risks are estimated for both average and high-end recreational and average and high-end tribal fishers.

4.2.2 The 95th percentile ingestion rate reported the Toy et al. (1996) should have been used to represent the fish ingestion rate of the high-end tribal fisher. Use of the 90th percentile is inconsistent with other Region X risk assessments (e.g., EPA, Ecological Risk Assessment and Seafood Screening Risk Assessment Asarco Sediment Site, October 1996) and will likely result in an under estimation of subsistence angler's fish consumption. A high-end exposure rate of 292 grams per day (about 10 ounces per day) should be used to calculate the predicted cancer risk rates. ~~EPA~~ used a fish consumption rate of 123 grams per day. (8, 26, 36)

Response: The choice of the 95th or the 90th percentile fish consumption rate must be made on a site-by-site basis in order to best represent site-specific exposures. EPA guidance directs that to calculate risks based on a reasonable maximum exposure (RME), a combination of average and high-end values for exposure parameters be used to estimate exposures. Such a combination is expected to result in an RME that is a realistic representation of risks to individuals with some of the highest exposures (90th to 95th percentile) at the Site. Therefore, it is not necessary to use the highest values available for all parameters to establish the RME scenario. For the CB/NT Site, it was determined that in combination with other parameters, the 90th percentile ingestion rate would be a realistic and protective value to represent some of the most highly exposed tribal fishers at the Site.

In the Screening Risk Assessment done for fish consumption at the Asarco site, a range of fish consumption values (from 1 gram of fish per day to 292 grams of fish per day) was used. The highest value (292 grams per day) was based on the 95th percentile consumption rates for the Squaxin Island Tribe in the draft version of the Toy *et al.* study. The 95th percentile ingestion rates in the final Toy study are lower than those in the draft, but somewhat higher than those used in the CB/NT PCB residual risk evaluation. EPA chose to use the 90th rather than the 95th percentile ingestion rate for the reasons discussed above.

4.2.3 In the calculation of risk to people consuming fish from the Hylebos Waterway, the assumption that 100 percent of fish consumed from Commencement Bay came from the Hylebos Waterway is an overestimate. The Hylebos Waterway is not a prime fishing area and studies indicate that the fraction of fish caught in the Hylebos is no more than 5 percent of the total caught in Commencement Bay (Pierce et al., 1981). (17)

Response: EPA is primarily using the CB/NT-wide human health risk calculations, not the Hylebos Waterway scenario, for decision-making purposes. The Hylebos

Waterway scenario was developed only as a check to ensure that a cleanup level based on the CB/NT risk evaluation would not result in an unacceptable risk to someone who did obtain a large amount of fish from the Hylebos Waterway. Furthermore, EPA evaluates potential cleanup levels using both current and potential future use scenarios for a site. For this reason it is not sufficient to decide whether or not to evaluate a scenario based solely on data collected in 1981.

4.2.4 Data demonstrate that there can be up to 90 percent PCB losses during frying of fish (Landolt et al., 1987) and frying is the most common preparation method. Yet, in the risk calculations, it was assumed that 100 percent of PCBs remained in the fish. (17)

Response: See response to Comment 1.1.8.

4.3 Comments related to the toxicity of PCBs to people

4.3.1 As a practical matter, it is incongruous to accept a decrease in the PCB toxicity factor from 7.7 to 2.0 without making a corresponding change in magnitude to the cleanup level. (25, 30, 13)

Response: As noted in response to Comment 1.1.2, in order to best represent the most current EPA policies and most current scientific data, all parameter values used to calculate risks were reevaluated. The PCB toxicity factor is not the only input parameter value to be updated since the ROD (see parameter values used in the Addendum [Weston, 1997a]). Therefore, the resulting change to risk estimates, and consequently, to the proposed PCB cleanup level, is not solely proportional to the change in the PCB toxicity factor.

4.3.2 The cancer-based human health risk assessment does not acknowledge or address the wide range of non-cancer health effects associated with PCBs. (3, 36)

Response: In the human health risk assessment done for Commencement Bay in 1985, the potential for both cancer and non-cancer health effects from exposures to PCBs in fish from the Bay was evaluated. Based on the information available on the toxicity of PCBs at that time, it was concluded that the potential for non-cancer impacts was not of concern. Therefore, when the ROD was written in 1989, EPA based its cleanup level for PCBs on human health cancer risks from ingestion of PCB-contaminated fish caught in the Bay.

Similarly, in the updated risk evaluations (Weston 1996, 1997a,b), EPA focused on cancer risks associated with PCBs, and updated non-cancer risk information was not presented in these reports. In response to comments EPA received on the Weston report, EPA has prepared a technical memorandum which provides information regarding non-cancer risks under current and post-cleanup conditions using the scenarios developed for the cancer risk evaluation. This technical memorandum has been added to the Administrative Record for EPA's final decision (Weston, 1997b). A summary is provided below.

Based upon an understanding of the development of non-cancer health effects, potential non-cancer impacts are evaluated by EPA assuming that there is a level of exposure below which health impacts are unlikely to occur. The estimate of this level of exposure is called the reference dose, or RfD, and is defined as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime." Exposures that are less than the RfD are not likely to be associated with adverse health impacts. (See the response to Comment 4.3.3 for more information on the RfD for PCBs that was used to estimate non-cancer health impacts.)

In order to calculate non-cancer risks for site-specific risk assessments, EPA compares the RfD to the exposures estimated for that site (e.g., from eating contaminated fish). This comparison, called the Hazard Quotient or HQ, is the ratio between the estimated site exposure and the RfD. As with cancer risk, the assumptions used in calculating the HQ are conservative ones (health protective) to ensure that remedial decisions based upon them will protect more sensitive individuals. Because of the way in which the HQ is derived, it should not, however, be viewed as a strict demarcation between toxic and nontoxic.

Results of this non-cancer risk evaluation show that, as for cancer risks, current conditions in the CB/NT Site are of concern for people who may be eating large amounts of fish from the Site. Under current conditions for the high-end tribal fisher, the HQ is 60. Under the 450 μg/kg PCB cleanup level, the HQ would be reduced to 8 immediately after cleanup and to 7 in 10 years after cleanup. Under the 150 μg/kg PCB cleanup level in the 1989 ROD, the HQ would be reduced to 7 immediately after cleanup and to 6 in 10 years after cleanup. For an average tribal fisher, these HQs would be reduced by a factor of 3. Both the cleanup required under the 1989 ROD and in the ESD (EPA, 1997a) provide for substantial reduction in the non-cancer risks associated with PCBs in sediments at the CB/NT Site. As with cancer risks, given the range of uncertainty in risk calculations, these post-cleanup HQs are not significantly different. Therefore, as with cancer risks, EPA does not believe that the 450 μg/kg PCB cleanup level provides significantly different non-cancer risks than the PCB cleanup level presented in the 1989 ROD.

It should be noted that HQ values above 1 do not mean that non-cancer health impacts will occur, but rather that the potential for such impacts increases as 1 is exceeded. The potential for impacts depends on a number of factors, including the protectiveness of both the RfD and the exposure assumptions used to calculate the HQ. As described in the response to Comment 4.3.3, the derivation of the RfD for PCBs is based upon a large body of experimental data and incorporates a several-hundred-fold uncertainty factor ("safety" factor) to ensure protection. Also, the exposure assumptions used in the CB/NT risk evaluation were selected to be protective for a consumer of large amounts of fish from the CB/NT Site over a 30-year period. Given these conservative assumptions, the small increases above an HQ of 1 estimated for the various target cleanup levels and for background suggest a low potential for non-cancer impacts for the fish consumers considered in the calculations. Individuals who eat less fish from the CB/NT Site will have exposures and HQs that are lower and, therefore, their potential for non-cancer impacts will be less.

4.3.3 EPA's Reference Dose (RfD) does not acknowledge or address the wide range of non-cancer health effects associated with PCBs including impacts on the immune system; reproductive and developmental system (miscarriages, impaired testicular descent, genital deformities, and other general impairments in reproductive and sexual development); neurological system (lowered intelligence, behavioral problems); and endocrine system (including hormone mediated cancers and the human breast cancer connection) and the fact that embryos, fetuses and young children are at much greater risk than adults particularly with respect to the hormone disruption impacts of PCBs. (8, 26, 36)

Response: In developing the RfD for a specific chemical, EPA scientists review all of the non-cancer studies on that chemical, including those done on experimental animals and those done on humans that have been exposed to the chemical. Experimental animal data are often from experiments performed on different species and at different exposures. From these data, the study showing the toxic effect at the lowest level of exposure is chosen as the "critical study." The level in this study at which no effect was seen (or the lowest level, if effects were seen at all exposure levels) is then selected and uncertainty factors are applied to this level to account for uncertainties in the database (e.g., in using animal data) and to protect sensitive individuals (e.g., the fetus, children, asthmatics).

The EPA RfD used for calculating the HQs (Hazard Quotients) discussed in Comment 4.3.2, is the RfD for Aroclor 1254 (an industrial mixture of PCBs) (EPA, 1997b) since this was the mixture that most closely approximated the PCBs present in CB/NT sediments. EPA published this RfD in 1994. In developing this RfD, scientists from several EPA offices reviewed all of the published (and some unpublished) literature (over 90 studies) on the non-cancer effects of PCBs. These included studies that were conducted on several species of experimental animals as well as studies on human populations that had been exposed to PCBs. The types of effects studied in experimental animals ranged from very obvious toxicity (e.g., death, reduced survival, obvious reproductive effects like gross abnormalities and reduced litter size, and organ damage) seen at higher exposures to PCBs to those that are more subtle (e.g., immunological effects and impacts on blood chemistry) and which can occur at lower exposures. The exposure levels in the animal studies ranged from those as low as 5 μg/kg-day (micrograms per kilogram per day) to those that were thousands of times higher. The number of human studies available and the types of effects studied were less than that for experimental animals, but both obvious and more subtle toxicological effects resulting from occupational and accidental exposures were reviewed.

The data chosen to develop the RfD (the "critical study") was a series of studies on rhesus monkeys that had ingested PCBs for five years at levels as low as 5 μg/kg-day (the lowest level of exposure studied in animals) (Arnold *et al.*, 1993a, 1993b; Tryphonas *et al.*, 1989, 1991a, 1991b). A battery of effects was studied including impacts on general health, blood chemistry, the immune system, reproductive endocrinology, and hormone levels. This study was chosen for the RfD because it was technically sound and it showed effects at the lowest dose of PCBs tested. These effects included inflammation of the eyelid glands and eye discharge; changes in the fingers and toenails such as elevated nail beds and abnormal nail foldings; and an inability of the immune system to respond. A "safety" or uncertainty factor of 300 was applied to the lowest effect level seen in this study (5 μg/kg-day) to account for several uncertainties, including extrapolating from monkeys to humans, to protect sensitive individuals in the human population, and to account for the use of data where the lowest effect (rather than no effect) had occurred. Therefore, the final RfD of 0.02 μg/kg-day is at a level that is 300 times lower than the level at which an effect was seen.

At the lowest levels tested, this study did not show effects on the menstrual cycle or on estrogen levels. Effects on reproduction and on the offspring of these monkeys has not yet been published but a preliminary review of the unpublished data by EPA indicated that there may be reproductive effects at the lowest level tested. This is in contrast to another study done on rhesus monkeys (Levinskas *et al.*, 1984) which showed no reproductive effect at the 5 μg/kg-day level. The Levinskas study included evaluations of the exposed adults as well as the offspring of these adults. In both the adults and their offspring, in addition to clinical analyses of toxicity (e.g., skin and eye problems), studies were done on blood and urine chemistry. The adults were also studied for male reproductive effects and female conception rates. This study found no effect at the 5 μg/kg-day exposure level.

It should be noted that potential adverse impacts on several of the organ systems mentioned by the commentors as being of concern for PCBs were looked for in the animal studies done on PCBs and were considered in the development of the 1994 RfD. Effects on some of these systems were not observed seen until exposures exceeded that used in developing the RfD (the lowest effect level); therefore, the RfD is expected to be protective for these effects that are occurring at higher exposure levels.

Some commentors stated that EPA was ignoring several studies of non-cancer health impacts in humans. In developing the RfD, EPA reviewed the available human data on the non-cancer effects of PCBs, but concluded that these data were only useful in a qualitative manner. Studies have been done on the general population who were exposed to PCBs via consumption of contaminated food (e.g., fish). Infants have been evaluated for impacts on the nervous system and on behavior after being exposed in the uterus or through breast feeding. However, the types of PCBs to which these populations were exposed, the levels of PCB exposure, the levels of exposure to other contaminants (e.g., in fish and breast milk), and other details of exposure are not known, making it very difficult to use these data to calculate an RfD. This is also true for studies of workers exposed to PCBs. Although the majority of the human studies of toxic effects of PCBs is from occupational exposures, these data are insufficient to develop an RfD due to lack of information on the levels of PCB exposure and concurrent exposures to other chemicals.

Some commentors criticized EPA for not considering endocrine-disrupting effects in the development of its RfD. An endocrine disrupter is an agent that interferes in some way with the natural hormones in the body (e.g., those secreted by the pituitary, thyroid, pancreas, adrenal, testes and ovaries). An agent might disrupt the endocrine system by affecting any of the various stages of hormone production and activity. A variety of chemicals, including PCBs, have been found to cause endocrine disruption in laboratory studies, including disruption of female and male reproductive function (such as sperm production, ability to conceive) and effects on the thyroid gland, which helps maintain normal metabolism. It should be noted that several of the experimental animal studies reviewed in developing the RfD for PCBs looked for these types of effects. Also, some of the human endocrine disrupter data cited by the commentors as not being considered by EPA in its RfD development (e.g., neurobehavioral effects in children) were reviewed for the RfD. As discussed above, these studies could only be used in a qualitative manner.

Since the development of the RfD in 1994, there has been additional research done on endocrine disruptors. A review of all of the research on endocrine disruptors, including this newest data, was completed by EPA's Risk Assessment Forum in February of 1997 (EPA, 1997c). In its report on this review, EPA concluded that, with few exceptions, a causal relationship between exposure to a specific environmental agent and an adverse health effect in humans operating via endocrine disruption has not been established. Exceptions are incidents of high chemical exposures in the workplace and exposure to the drug, DES. For example, conclusive evidence linking environmental exposure to endocrine disruptors with infertility or cancers of the breast or prostrate (all mentioned by the commentors) is not available at this time.

The 1997 report also recognized that there is concern about the possibilities of impacts to human health due to exposure to endocrine disruptors, including the potential risk to the developing young who may be at more risk than adults (as mentioned by the commentors), and that more research into this area and into other areas mentioned by the commentors needs to be done. EPA is preparing a draft research policy on endocrine disruptors that will be released later this year. EPA has also established a task force to develop screening and testing methods for use in evaluating chemicals for endocrine effects. Efforts are underway to coordinate endocrine disrupter research throughout the federal government.

Finally, EPA will soon complete a reassessment on the toxicity of and exposures to chlorinated dioxins and furans, as well as dioxin-like PCBs. Dioxin-like PCBs are those PCBs having a chemical configuration similar to chlorinated dioxins and furans, and which are, therefore, thought to act in a toxicologically similar fashion to dioxins and furans. The results of the review of existing data and the new data generated by this reassessment could have an impact on the way in which non-cancer impacts from this specific group of PCBs are evaluated.

The results of the research efforts described above will be used by EPA scientists to determine whether a modification to the PCB RfD is necessary. If EPA decides to significantly modify the RfD for PCBs, it may be necessary for EPA to reevaluate cleanup decisions made at Superfund sites where PCBs are a contaminant of concern to determine whether the cleanups at those sites are still protective of human health and the environment.

4.3.4 Because of the limited numbers of hormone receptors in developing human embryos and fetuses, the fact that hormones are already operative, and the essential role hormones play in survival and proper development, a strong case can be made that there is no safe level for PCBs. (36)

Response: If by a "safe level," the commentor is referring to a "no adverse effects" level, EPA agrees that this may be the case for many cancer-causing chemicals. Because of the way in which chemicals are thought to cause cancer, EPA assumes that it is not possible to define a level for exposure to a cancer-causing chemical which it is certain will be associated with no effects. Therefore, all exposures are assumed to potentially have some risk associated with them with the risk of developing cancer increasing as the exposure increases. EPA regulations require that Superfund cleanups achieve a reduction in contaminant concentrations such that the chance of developing cancer under a "reasonable maximum exposure" scenario is within the range of 10^{-4} to 10^{-6}.

For the non-cancer effects of a chemical, it is assumed that a "no adverse effects" level of exposure can be determined—this level is defined as the RfD (Reference Dose) by EPA. In developing the RfD for PCBs (discussed in detail in the response to Comment 4.3.3), all of the available non-cancer data on PCBs were considered, including those relating to adverse hormonal impacts.

However, as discussed in its recently released review on endocrine disruptors (see Comment 4.3.3), EPA recognized the need for further research on exposure of neonates and the human fetus to environmental levels of endocrine disruptors and discussed several ongoing efforts to expand and improve upon the research in this area.

The results of this research should provide further information on the question of a safe threshold for non-cancer impacts due to PCBs.

4.4 Comments related to ecological exposures to PCBs at the CB/NT Site

4.4.1 The bioaccumulation model assumes that piscivorous birds (fish-eating birds) obtain all of their prey (forage fish) within the Hylebos Waterway. This assumption overestimates the exposure of migratory birds or birds with large foraging ranges, like the eagle. (17)

Response: EPA primarily used the CB/NT-wide risk estimates, not the Hylebos Waterway risk estimates, for decision-making purposes. The waterway-specific information was used, however, as a check to ensure that a cleanup level was not selected that would have a disproportionately large impact to individuals who preferentially utilize one waterway. EPA believes that this is a reasonable approach based on FWS information indicating that individual birds can demonstrate a high degree of site fidelity in their foraging/hunting activities (Krausmann, 1996). See also EPA's response to Comment 3.3.4.

It should be noted that the primary basis for EPA's decision on the PCB cleanup level was the human health risk evaluation. The wildlife risk evaluations provided in FWS comments (FWS, 1996a,b) and the 1997 Weston report were used only to confirm that the selected PCB cleanup level for protection of human health would also be protective of ecological receptors. It should also be noted that EPA did not use the eagle data provided by FWS for decision-making purposes, due to concerns about the uncertainty associated with the biomagnification factor and the lack of data on foraging ranges.

4.4.2 The use of BSAF of 1.7 should be reevaluated. Current models and studies in the scientific literature recommend a BSAF of 4. (24)

Response: See response to Comment 1.5.1.

4.4.3 The use of an average total organic carbon (TOC) value for the various waterways may not be appropriate. The lowest TOC value representative of an area in the waterway should be used to more accurately reflect what a species with site fidelity would be exposed to. (24)

Response: The distribution of total organic carbon represents a gradient of low TOC at the mouth and high TOC at the head in both the Thea Foss and Hylebos waterways. Use of the lowest TOC would reflect only a small portion of the waterway. It is more accurate to represent exposure based on prevailing conditions, which are better represented by the mean TOC for the waterway.

4.4.4 Fish in Commencement Bay contain high levels of PCBs in their bodies. A recent study by the National Marine Fisheries Service (NMFS) in the Hylebos Waterway of Commencement Bay links the presence of PCBs to altered sexual reproduction of flatfish. In the studies, half *of all juvenile female flatfish showed signs of premature sexual development. The same study also revealed levels of PCBs in young salmon found migrating through the Hylebos Waterway were comparable to levels found in other young salmon in the Duwamish River. The Duwamish River study documented impaired growth, suppression of immune function, and increased mortality rates after exposure to pathogens. English and rock sole in the Hylebos Waterway have high rates of liver lesions which are associated with PCBs in their bodies. Despite the passage of 10 to 15 years and some remediation, there has been no real improvement in terms of exposures and injuries for these fish. (8, 26, 36)*

> **Response**: EPA agrees that current conditions are adversely impacting fish in the Hylebos Waterway, which is one of the reasons EPA wants to complete the sediment cleanup as soon as possible. The NMFS studies, however, do not provide information about a PCB cleanup level that would prevent such effects from continuing to occur.

4.4.5 In the last two years, we have seen an increase in predation on the great blue heron colony by bald eagles. We believe these eagles are at further risk of adverse impacts due to the nature of PCBs bioaccumulating through the food chain. (35)

> **Response**: Although raptors may represent sensitive receptors, EPA does not have sufficient data to evaluate the risks to these receptors at this time. It is EPA's understanding that FWS is conducting work that would support this evaluation, but that these data are not yet available.

4.4.6 Fish-eating birds, such as bald eagles and blue herons, in the Commencement Bay area have high levels of PCBs in their embryos. PCB levels in blue heron eggs from Dumas Bay, located near Commencement Bay, are 5 to 10 times higher than the observed level at which negative effects occur. The herons from Dumas Bay use Commencement Bay as their feeding grounds. (8, 26, 36)

> **Response**: It is EPA's understanding that FWS is conducting work that would support the evaluation of threats to heron and bald eagle, but these data are not yet available. EPA agrees that at current conditions, PCBs in sediments may be adversely affecting piscivorous birds, and may present an imminent and substantial endangerment to wildlife until a cleanup is implemented. EPA has included an evaluation of the potential impacts to piscivorous birds from ingestion of contaminated prey, based on the herring gull data from the Great Lakes, to ensure that the selected PCB cleanup level will be protective of wildlife.

4.5 Comments related to the ecological toxicity of PCBs

4.5.1 We disagree that the range of LOAELs (Lowest Observable Adverse Effects Levels) presented represents a variability of risk, and therefore uncertainty, in the risk assessment. For example, the adverse effects associated with levels of PCBs in the egg of a bald eagle do not increase or decrease the adverse effects observed and associated with the levels of PCBs in the egg of a Caspian tern. The risk assessment calculated hazard quotients for birds based on the "average LOAEL presented by the FWS." (emphasis added). However, the tables presented by the FWS on LOAELs were intended to show the levels of total PCBs associated with adverse effects to specific bird and wildlife species from various published literature sources. Data from this table was not averaged in its original presentation nor was the intent to imply that averaging effects to individual species would be appropriate in an ecological risk assessment designed to determine overall protectiveness for fish and wildlife. Risk should be calculated for the most sensitive of the species of concern if the intent is to be protective of that species. (35)

> **Response**: EPA agrees that it is important to protect for sensitive species. There was little difference in the lowest observable adverse effects levels (LOAELs) reported for piscivorous bird egg effects (3.5 to 5.0 mg/kg). Use of the LOAEL for the most sensitive species (double-crested cormorant; 3.5 mg/kg) compared to the average (4.2 mg/kg; equivalent to the Caspian tern LOAEL) would have resulted in only a small change in the hazard quotient and would not have changed the overall interpretation of the estimated risk.

4.5.2 It is well established that PCBs can have significant genetic and reproductive effects to fish and wildlife at low concentrations. Because of the ecological significance of these effects, specifically to the viability of fish and wildlife populations which utilize Commencement Bay, a conservative approach to the ecological evaluation is warranted. (24, 36)

> **Response**: As noted in response to Comment 4.4.1, EPA's primary basis for decision-making on the PCB cleanup level was the human health risk evaluation. EPA used information about ecological risks presented in the FWS comment letters (FWS, 1996a,b) and the Addendum (Weston, 1997a) to confirm that the PCB level considered protective of human health would also be protective of ecological receptors. As discussed in the response to Comment 1.6.2, EPA has used the information provided by the FWS and NOAA to evaluate the risks to wildlife. EPA used the PCB bioaccumulation models provided by the FWS to address impacts to higher order receptors, such as fish-eating birds that may bioaccumulate PCBs through the food chain, in the evaluation of the potential for impacts to ecological receptors. EPA assumed piscivorous birds were obtaining 100 percent of their diet from the CB/NT Site. EPA also used the arithmetic mean to represent the residual PCB concentration, which, as discussed in responses to Comments 1.2.2, 4.1.2, and 4.1.5, is a conservative representation.

4.5.3 Using cancer as an end point in the assessment process for PCB's does not account for the true injury to the biota of Commencement Bay and will not be protective of these biota. (29, 36)

Response: EPA agrees. Cancer was not used as the endpoint for evaluation of the risks to wildlife. Rather, EPA evaluated reproductive effects in piscivorous birds, growth and survival in juvenile salmonids, and abundance and diversity of benthic infauna to determine the potential effects to wildlife, under various cleanup scenarios proposed for the protection of human health.

4.5.4 According to the United States Fish and Wildlife Service and the National Marine Fisheries Service studies, PCBs cause not only increased mortality rates, but several other short-of-fatal but serious problems. These include impaired growth, suppression of immune function and impaired or premature sexual development. The results of the FWS model (FWS, 1996) indicate that by leaving 450 μg/kg of PCBs in the Commencement Bay environment, fish-eating birds could accumulate levels of PCBs 5 to 10 times higher than levels where we would first expect to see adverse reproductive impacts such as embryonic deformities and death. Not only is it unconscionable to knowingly permit such harmful levels to continue, it is simply wrong-headed to believe that humans will escape the effects of such toxic chemical substances. Thirty μg/kg will protect fish-eating birds, so we are assured that even 150 μg/kg is high for fish. (3, 35)

Response: EPA agrees that PCBs in CB/NT sediments at current concentrations may present an imminent and substantial endangerment to a variety of wildlife species and people. EPA agrees that PCBs should not be allowed to remain in CB/NT sediments at current concentrations.

The commentor is correct that FWS has recommended a 30 μg/kg PCB cleanup level to protect fish-eating birds. FWS assumed that after cleanup, fish would reside in areas where they would be exposed to only the maximum PCB concentration remaining in sediments, and that birds would only eat fish that had these high exposures.

EPA's policy is to use a "reasonable maximum exposure" scenario in developing cleanup levels for Superfund sites, which is defined as the highest exposure that is reasonably expected to occur at a site. The area within the CB/NT Site where maximum PCB concentrations (i.e., PCB concentrations at the cleanup level) will occur post-cleanup will be quite small. In the evaluation of the impacts to wildlife at various PCB cleanup levels, EPA assumed that fish would move about within the waterways and be exposed to average PCB concentrations, rather than maximum concentrations. EPA used FWS's estimates to predict the impact to birds eating these fish. Based on EPA's analysis, the impacts to birds and fish at the 450 μg/kg PCB SRAL and 300 μg/kg PCB SQO are not appreciably different than the impacts at the original 150 μg/kg PCB SQO.

4.5.5 PCBs are one of several chemicals known to disrupt the endocrine systems of birds and mammals. Other studies of PCBs show impaired sexual development in marine life. Small penises in young Columbia River otters have been linked to PCBs in their bodies and these young otters do not appear to be able to produce sperm. (8, 26, 36, 29)

> **Response:** EPA is also concerned about the potential for PCBs to disrupt endocrine systems, as discussed in the response to Comment 4.3.3.

4.5.6 The new wildlife criterion for aqueous concentrations of PCBs in the Great Lakes (EPA, 1997) is 1.2×10^{-4} ng/mL. This is based on an average log K_{ow} of 6.59. PCBs are expected to partition similarly in freshwater and marine systems. Equilibrium partitioning can be used to predict the sediment concentration that should produce this aqueous concentration. The equation: $[sed]/f_{oc} = K_{oc} * [water]$, is used to predict sediment concentration that will produce the criterion concentration of 1.2×10^{-4} ng/mL. Setting $K_{ow} = K_{oc}$, the predicted sediment concentration is 466 ng/g organic carbon. For a TOC of 2.4 percent, the sediment concentration would equal 11.2 ng/g. (24)

> **Response:** While some PCBs may partition to the water column, chemical properties of PCBs will result in a significantly larger amount remaining in the sediments. Therefore, EPA does not believe it is appropriate to increase the uncertainty associated with the risk estimates by extrapolating to another medium (i.e., water). Furthermore, the approach suggested by the commentor proposes to make additional extrapolations and assumptions (e.g., $K_{ow} = K_{oc}$) that add more layers of uncertainty to the risk estimates. EPA believes the approach utilized in the human health and ecological risk evaluations presented in the Addendum (Weston, 1997a) is a more appropriate evaluation for the conditions present at the CB/NT Site.

4.6 Comments Relating to additional exposure to contaminants

4.6.1 Combinations of chemicals can be far more deadly than PCBs acting alone. Combinations of PCBs and other pollutants can also have much greater effects than the chemicals considered one at a time. PCBs are not the only pollutants in sediment, in animals, in people's daily environments, and in people's fat, food and breast milk. At a minimum, each person carries 250 synthetic pollutants in his or her body. More and more studies have documented that combinations of chemicals can have far worse effects than chemicals in isolation. This proposal does not consider the overall risks due to the synergistic or additive nature of these chemicals with PCBs and their impacts on the natural resources which inhabit this embayment. (36, 29)

> **Response:** The available scientific data on mixtures (including those of endocrine disruptors) are primarily from laboratory experiments and some occupational studies. These data suggest that exposures to multiple chemicals may result in the following toxicological effects : (1) additivity such that the resulting toxicity is equivalent to the sum of the toxicity of each chemical alone; (2) antagonism such that the resulting

toxicity is less than the sum of each chemical added together; or (3) synergism such that the resulting toxicity is greater than the sum of the each chemical added together. However, the current database is not complete enough to determine which of these effects are occurring from a particular environmental exposure or to quantify these effects. Therefore, EPA's current approach is to assume additivity of effects (EPA, 1986). For this assumption, the combined effects of antagonism and additivity are assumed to balance the possible effects of synergism.

For carcinogenic effects, additivity is assessed in the Superfund program by combining the cancer risks resulting from chemical exposures from the site contaminants. For non-cancer effects, additivity is applied to site-related contaminants that produce their toxicological effect by similar types of actions (e.g., specific impacts on the immune system). As a first step, all of the HQs (see Comment 4.3.2 for a definition of the HQ) are added, and the combined HQ for all contaminants is evaluated.

In the human health risk assessment done for the CB/NT Site in 1985, the potential for both cancer and non-cancer health effects from exposures to contaminants in fish from the Site was evaluated. This evaluation was done using data on contaminant levels in fish tissue collected from several parts of the Site, as well as from Carr Inlet, which was selected as the reference or background site. EPA toxicity values were used with these observed fish contaminant levels and a range of fish ingestion rates (up to 1 pound or 454 grams per day) to estimate potential cancer risks and non-cancer hazards. The mixtures of PCBs present at the CB/NT Site were accounted for in this risk assessment because the toxicity data used and the chemical contaminant data from fish were those for the mixture of PCBs at the Site.

The risk assessment concluded that, for chemicals that are potentially carcinogenic, three of these are present in fish tissue at levels different from the levels in background (Carr Inlet) fish—PCBs, tetrachloroethene, and bis(2-ethylhexyl)phthalate (BEHP). The risks for tetrachloroethene and BEHP were more than an order of magnitude lower than for PCBs. For chemicals with non-cancer effects, it was concluded that only three chemicals were at levels that are slightly above (less than 2 times higher) the Acceptable Daily Intake (ADI) (now called the RfD or Reference Dose by EPA), but that there is essentially no difference in the tissue levels of these three contaminants at the CB/NT Site versus Carr Inlet.

Although additivity of toxicity for these three site-related carcinogens was not explicitly addressed in the risk assessment, the predicted risk values for tetrachloroethene and BEHP are so much lower than those for PCBs, they would not significantly add to the CB/NT Site risk due to PCBs.

As discussed in the response to Comment 4.3.3, new research is being done on endocrine disruptors and dioxin-like PCBs. It is possible that the results of this new research could change the methods EPA currently uses to assess mixtures of PCBs and mixtures of endocrine-disruptors like PCBs.

4.6.2 PCBs are but one of several classes of chemicals known to disrupt the endocrine systems of fish, wildlife and humans (Colborn, 1993). Other "endocrine-disrupters" such as certain pesticides, heavy metals, and other industrial chemicals are known to exist in various quantities in the CB/NT Site. The current proposal makes no reference to how the proposed changes in the PCB cleanup level will affect overall risk due to the synergistic or additive nature of these other chemicals remaining in the Commencement Bay environment. To date, the FWS has provided the EPA with information concerning the adverse impacts of elevated PCBs on fish and wildlife in Commencement Bay. However, literature suggests that, at the very least, adverse impacts to fish, wildlife and humans may be additive in the presence of other endocrine-disrupting chemicals (Colborn, 1993). (35)

Response: Please see responses to Comments 4.3.3 and 4.6.1.

4.6.3 I urge EPA to think about the concept of global loads of PCBs in the Commencement Bay decision. Your narrow analysis misses the big picture of a planet which desperately needs your leadership in many different sites concurrently to reduce the overall PCB loadings in the global environment. Many studies have documented that people who live far away from any sources of pollutants have some of the highest levels of these pollutants. Scientists now understand that this is the result of pollutants volatilizing in warmer regions, traveling by air to colder regions, and condensing there. We request that EPA investigate and factor in evaporation and deposition routes of exposure for people living in colder regions where PCBs have been documented to collect via transfer from industrial areas. (36)

Response: EPA agrees studies have shown that PCBs have been transported globally and can be found in remote and non-industrial regions. However, EPA's Superufund regulations require that cleanup decisions be based on potential exposures and health impacts from contaminants from a specific Superfund site. The concept of global loadings is not considered in the Superfund law or regulations. For the CB/NT Site, decisions have been based on protection of those individuals who are expected to have the highest exposure to site contaminants. EPA believes that by selecting cleanup levels that are protective of those living close by the site and who will have the highest potential exposure to site contaminants, (in this case, a tribal fisher who eats a higher than average amount of fish from the site), the selected PCB cleanup level will also be protective of those who live further away and receive a smaller dose through air transport. Because of the low solubility of PCBs, the potential dose of PCBs one might receive from their partitioning from sediments to the water column and then entering the atmosphere from the CB/NT Site is quite small, especially when compared to the dose received by eating PCB-contaminated fish.

4.6.4 Even if the concept of safe thresholds of PCBs and other pollutants is still valid—a matter in great dispute—fish, people and other animals are so contaminated with PCBs and *other pollutants already that we have passed those thresholds. Study after study have shown that fish, people and other animals are carrying very significant quantities of these PCBs in our bodies. A risk assessment cannot accurately depict risk if it does not take these levels into account. (36)*

Response: EPA recognizes that people may be exposed to a variety of chemicals in everyday life, in addition to potential exposures from a Superfund site. Because each individual will have different exposures based on their occupation, place of residence, and lifestyle, it is difficult to develop a method which accounts for these varied exposures. Instead, EPA's Superfund regulations and guidance focus on the lifetime excess cancer and non-cancer risks from exposure to Superfund site contaminants and bases cleanup decisions on those risks. EPA assumes that receptors do have other exposures than those from the Superfund site, and strives to set Superfund cleanup levels that do not pose an unacceptable additional risk.

PCBs are carcinogenic chemicals, for which EPA does not recognize a "safe" threshold. However, in assessing carcinogenicity to humans, EPA has set a standard that estimated lifetime excess cancer risks on the order of 10^{-4} to 10^{-6} fall within an acceptable range. EPA evaluates all risks to ecological receptors based on a variety of effects, for which a threshold value is recognized. Risks to ecological receptors are calculated using lowest observed adverse effects levels (LOAELs) or no observed adverse effects levels (NOAELs). Exposures that exceed these thresholds are identified as potential risks.

4.6.5 With thousands of pollutants in the environment and a minimum of hundreds in each person, how will you account for the myriad of potential combinations of exposure? Will you test each combination? Will you have side calculations in your risk assessments for each possible combination? (36)

Response: See responses to Comments 4.6.1 and 4.6.4.

5 Comments Related to Remedial Decision-Making

5.1 Comments related to the protectiveness of the proposed PCB cleanup level

5.1.1 The risk assessment is based on sediment concentrations and, as such, has a higher degree of uncertainty than an assessment based on fish tissue concentrations. Because of this higher degree of uncertainty, it is not sufficiently protective to utilize a cleanup level that has a low margin of safety, such as the proposed 450 μg/kg PCB cleanup level. At the 450 μg/kg cleanup level, both the estimated incidence of cancer and the Hazard Indices are at the high end of the acceptable range. A more restrictive (lower) cleanup level would be more protective of ecological health. (34, 11)

Response: EPA agrees that the 450 μg/kg PCB SRAL falls at the high end of a range of cancer and non-cancer risks which EPA has determined to be acceptable for Superfund cleanups. EPA has now added a requirement that PCB concentrations in sediments must be reduced to 300 μg/kg within 10 years after remedial action. This will ensure that human health cancer risks are reduced by an additional 14 percent in the 10 years following remedial action. It should be noted, however, that all PCB cleanup levels examined from 450 to 150 μg/kg result in residual risks at the high end of EPA's risk range, due to the conservative scenario used for risk calculations (a high-end tribal fisher who fishes exclusively in the CB/NT area).

If EPA's analysis had shown that cleanup to the 1989 PCB SQO of 150 μg/kg would result in a significantly smaller risks to humans or wildlife, and that such a cleanup was cost-effective, EPA would agree that lower PCB cleanup level in the 1989 ROD should be retained. However, EPA's analysis shows that residual ecological risks at the revised SQO of 300 μg/kg PCB are not significantly higher than the risks associated with cleanup to a 150 μg/kg PCB SQO under the 1989 ROD. See Tables 1 through 6 of the ESD (EPA, 1997a) for a comparison of the estimated risk values at current conditions, at the ROD PCB cleanup level, and at the new PCB SQO of 300 μg/kg and SRAL of 450 μg/kg.

5.1.2 Although below the 2LAET (second lowest Apparent Effects Threshold) of 1000 μg/kg, the proposed cleanup level of 450 μg/kg is significantly higher than the LAET of 130 μg/kg, which is the target sediment quality value set by the State of Washington Sediment Management Standards. As stated in previous comments, the proposed cleanup level of 450 μg/kg is also significantly higher than the median effects range (ER-M) concentration of 180 μg/kg. The ER-M is calculated from a national database of benthic invertebrate studies where more than half of the studies showed adverse effects to benthic invertebrates. (24)

Response: Even if this decision were being made under the State of Washington Sediment Management Standards (SMS), meeting the lowest apparent effects threshold (LAET) of 130 μg/kg PCBs is not an absolute requirement under the State law. EPA and the State have the discretion to chose cleanup values that fall between the range of cleanup values set in the SMS, based on several factors, including cost-effectiveness. The Washington Department of Ecology concurs with EPA's modification of the PCB cleanup level. See EPA's response to Comment 1.6.1 for a discussion of the ER-M, and to 2.1.1 for further discussion of the SMS.

5.1.3 EPA's risk assessment presents contrary views in the risk assessment uncertainties section in the ESD, which states: "The assumption used in the ecological risk evaluation will overestimate the exposure of species or individuals with large foraging ranges (such as migratory birds) and may underestimate the exposure of resident species that preferentially feed at a specific location." How was it determined that this methodology is therefore both "appropriate" and protective of human health and the environment when in the uncertainties *section it clearly states the proposed action may not be protective for resident fish and wildlife species. (35)*

Response: EPA believes that its ecological risk evaluation (Weston, 1997a) is conservative with respect to protection of ecological receptors, including resident species. While the CB/NT Site-wide risk estimate may underestimate risks to resident species because PCB concentrations are averaged over the entire Site, the Waterway-specific risk assessments for the Hylebos and Thea Foss waterways provide conservative estimates of risks to resident species which preferentially feed in a particular Waterway. The referenced statement has been clarified in the final ESD. See responses to Comments 4.5.2 and 4.5.4 for further discussion.

5.1.4 The ecological risk evaluation presented in the Addendum (Weston, 1997a) states that there will be an increased risk to fish and birds as a result of weakening the cleanup standards. The hazard index used to determine risk to these creatures shows that young salmon and fish-eating birds will be exposed to an unacceptable level of PCBs at the proposed 450 μg/kg cleanup level. (8)

Response: The analysis in the 1997 Weston report shows that there is little difference in the calculated risks at the three cleanup levels examined (150 to 450 μg/kg PCBs). All of the cleanup levels examined represented a safe level for fish and birds (i.e., hazard quotients are at or near 1.) (It should be noted that EPA did not use the eagle analysis in the Weston report or the FWS letter for decision-making purposes due to uncertainties associated with the biomagnification factor and the lack of data on the foraging range of eagles in the area.) In addition, cleanup of other contaminants of concern and natural recovery processes will further reduce the risks to these receptors.

5.1.5 Even under this averaging approach, the 450 μg/kg cleanup level will not be protective of fish and birds. The Record of Decision states that a 10-year goal of 150 μg/kg will result in an average concentration of 30 μg/kg in the bay and in the Hylebos Waterway (ROD, Section 7.1.4.). In a recent public testimony, the US Fish and Wildlife Service stated that a strengthening of the PCB cleanup standard is what is needed to protect fish-eating birds. However, under EPA's 450 μg/kg proposal, in ten years the average for the bay will be 63 μg/kg (no information was given about the Hylebos Waterway). The 450 μg/kg proposal will result in over twice the amount of PCBs in the bay. (8, 26, 36, 3)

Response: EPA based its evaluation of ecological risks presented in the Addendum (Weston, 1997a) on reasonable maximum exposures to ecological receptors. As discussed in response to Comment 4.5.2, EPA believes an adequate degree of conservatism was applied and that the proposed PCB SRAL of 450 μg/kg is protective of ecological receptors at the CB/NT Site.

Additionally, the residual sediment PCB concentration after cleanup to 450 μg/kg will be further reduced over time through natural recovery. EPA has added a requirement in the final ESD that PCB concentrations must be reduced to a minimum of 300 μg/kg within 10 years after remedial action, to ensure that PCB concentrations will be reduced over time. Additional cleanup will be done if PCB concentrations are not reduced to 300 μg/kg after 10 years.

5.1.6 EPA's own guidance calls for a cancer risk rate of no more than 100 in 1,000,000 yet EPA's cancer risk assessment predicts a cancer risk rate of 140 in 1,000,000 after the proposed cleanup at 450 parts per billion. EPA has the authority to require a cleanup level that will at least provide a cancer risk rate of 1 in 1,000,000. This decision barely met the 1 in 10,000 criteria, but EPA is willing to go ahead and judge it acceptable. You have hazard indices that do not meet the ratio of one, but EPA chooses to ignore those and decided the ecological effects were acceptable. (8, 26, 36, 3)

Response: To meet EPA's criterion for protectiveness of human health, cleanup actions must result in risks on the order of 10^{-4} to 10^{-6} or lower. EPA policy states that the upper boundary of the risk range is not a discrete line at 1 x 10^{-4}, and cleanups to levels slightly greater than 1 x 10^{-4} may be considered acceptable if justified based on site-specific conditions. For non-cancer health impacts, EPA's Superfund regulations do not contain a numeric standard, but state that EPA must achieve cleanup levels to which humans may be exposed without adverse effects during a lifetime or part of a lifetime, incorporating an adequate margin of safety. Cleanups must also be protective of ecological receptors. EPA believes this decision meets these standards, especially due to the conservative assumptions built into the human health and ecological risk assessments. Furthermore, risks will be further reduced over time due to natural recovery processes.

5.1.7 The Environmental Protection Agency is supposed to do just that: protect the environment. EPA's current proposal will not provide the best protection of the environment or to the people of the Commencement Bay community. EPA's position is unacceptable because the stakes are simply too high. The viability of wildlife populations, the survival of economies and cultures which rely upon them, and the health and intelligence of our children are all at stake. (36, 8)

Response: EPA's primary criterion in any Superfund cleanup decision is protection of human health and the environment. EPA's 300 μg/kg PCB SQO meets that standard, as did the 150 μg/kg PCB SQO in the 1989 ROD. Either level results in a major decrease in the human health and ecological risks currently present at the site immediately after cleanup, with further reductions over time due to natural recovery. In fact, EPA's decision here will result in the most stringent PCB sediment cleanup of any appreciable size anywhere in the United States. Most Superfund sediment cleanups elsewhere have set PCB cleanup standards of 1,000 μg/kg or higher. Commencement Bay will be protected to a greater degree than any other major Superfund site in the country.

5.1.8 The agency fails to recognize that cleanup issues are matters of civil rights. EPA weighs the costs of cleanup born by those who made the mess to begin with against the costs to be born by others. Instead of standing up for a clean environment for all, it treats polluters and their victims as equal "stakeholders," and it reopens a remedial action plan at the request of polluters to save them money. Trampled in the process is a simple justice—the right each person has to a clean environment. The civil rights issue is heightened by the fact that many Native Americans, Asian Americans and low-income people eat comparatively large quantities of fish each year, thereby suffering disproportionate exposures. EPA's oft stated commitment to environmental justice rings hollow when it ignores the environmental racism and injustice inherent in a recommendation to weaken cleanup standards. (36)

Response: EPA must make cleanup decisions that are protective of human health and the environment. EPA strives to protect human health by identifying those individuals among all affected people at the Site who have some of the highest current or potential future exposures to contaminants at a site. In the vicinity of the CB/NT Site, EPA acknowledges that there are some populations who are likely to be exposed to greater than average amounts of CB/NT PCBs because they consume greater than average amounts of CB/NT fish. In the Addendum (Weston, 1997a), EPA considers risks to high-end tribal fishers to represent a reasonable maximum exposure scenario on which to base its reevaluation of the PCB cleanup level.

EPA does not believe environmental justice is incompatible with its commitment to selecting cost-effective cleanup solutions for Superfund sites. EPA's 450 μg/kg PCB SRAL was selected to be protective of who may rely on Commencement Bay fish for an important portion of their diet, and also allows for a cost-effective cleanup.

5.2 Comments related to the application of balancing criteria

5.2.1 Six Superfund projects have completed remedial dredging to-date (Waukegan Harbor, Sheboygan River, GM Central Foundry, Bayou Bonfouca, New Bedford Harbor, and Marathon Battery.) Volumes of sediment removed ranged from 3000 cy to 159,000 cy. Overall costs ranged from \$140 to \$1430 per cubic yard, with an average of about \$700 per cy. For three of the six projects, the cost does not include final disposal, which hasn't occurred at the Sheboygan River, GM Central Foundry, or New Bedford Harbor. How does EPA justify estimating an average cost as low as \$73 per cy (Table 6, \$18 million)? (1)

Response: EPA used a cost estimate of \$35 per cubic yard for dredging and disposal of contaminated sediments. This estimate is based on a June 26, 1996, report prepared by Hartman and Associates and other consultants to the Hylebos Cleanup Committee entitled "Hylebos Waterway Pre-Remedial Design Preliminary Disposal Site Evaluation." The report was reviewed by EPA, the U.S. Army Corps of Engineers, and EPA's contractor, Roy F. Weston, Inc. This estimate is also based on experience with the Sitcum Waterway sediment remediation project, which was completed in 1994.

The six projects cited have significantly different situations and features than the Hylebos Waterway, or other problem areas within the CB/NT Site. Costs associated with dredging projects are extremely equipment- and location-specific, making it very difficult to reasonably compare costs among different projects unless the specific project requirements and features are compared. PCB contamination levels for the referenced projects are significantly higher than at the CB/NT Site. Many of the projects listed in the comment have proposed some sort of sediment treatment option, either incineration, low temperature thermal desorption, or fixation/stabilization; and confinement of some type, generally using upland disposal methods. All of these remedial options require operational, equipment and handling methods which add significant costs to these projects, compared to the CB/NT Site. In addition, the New Bedford project included items such as water treatment, and the Sheboygan project included upland sediment storage, armoring and stabilization, none of which is included in the CB/NT cleanup plan. The CB/NT cleanup plan includes capping or dredging and disposal of contaminated sediment in an upland or aquatic disposal facility. Because contaminant concentrations are low compared to other contaminated sites, it is not anticipated that specialized equipment, sediment treatment, water treatment, or special handling will be needed to protect water quality during cleanup. These items justify a significantly reduced unit price estimated for the CB/NT project, compared to the other projects.

5.2.2 EPA's Fact Sheet states that long-term effectiveness of the cleanup, reduction of toxicity, and short-term effectiveness would be affected by the proposed modification. The modification would increase risks to the marine environment, wildlife, and public health, especially through exposure pathways associated with remaining concentrated "hot spots" of 450 μg/kg PCB. In addition, Tribal and community opposition has been documented. In exchange for these impacts, cost would be reduced. We believe that this is an unbalanced and unacceptable exchange, and that consideration of all the remedy selection criteria do not support the proposed modification and that cost considerations discussed in the Fact Sheet are inappropriate in this case, given the delays in implementing the 1989 ROD cleanup plan. (28, 3, 8, 9, 36)

Response: EPA agrees that if increasing the PCB cleanup level had a significant impact on toxicity and short- and long-term effectiveness, a modification solely based on cost would not be justified. The PCB cleanup level was changed only because EPA's analysis showed that the reduction in toxicity and long-term effectiveness and any increase in risks to the marine environment, wildlife, and the public health will be small. In the analysis of short-term effectiveness, the 450 μg/kg SRAL ranks higher than the original cleanup standard because short-term impacts to the waterway during dredging are reduced as the volume of sediments to be remediated are reduced.

5.2.3 We are concerned with how the nine different and often conflicting criteria the EPA uses were each weighed and considered during the decision-making process. Attempts to avoid costs at this stage of the cleanup by implementing a less stringent cleanup effort may cost the *public a greater expense at a later date. Specifically, these long term costs to our natural resources from chemical contamination would likely include: diminished returns of healthy salmon and other fish species, and decreases in breeding bird populations in the Bay. (35)*

Response: The nine criteria EPA uses to evaluate and select Superfund cleanup actions are not weighted equally. The first two criteria, protection of human health and the environment and compliance with applicable, or relevant and appropriate requirements, are threshold criteria which must be met under all circumstances. CERCLA has some provisions for waivers of other laws, but includes no waivers for the requirement of protectiveness. The next five criteria: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost, are considered balancing criteria. EPA strives to achieve the best balance of these criteria in remedy selection. The last two criteria, state and community acceptance, are modifying criteria. EPA may modify its decision based on these criteria.

With regard to the ecological concerns mentioned in the comment, EPA must meet the threshold criterion of protection of humans and wildlife in selection of the PCB cleanup level. When EPA's analysis shows, as it did in this case, that a range of PCB cleanup levels would meet the criterion for protectiveness, we use the other criteria to help select the cleanup level that provides the best balance of the remedy selection criteria.

5.3 Comments related to natural recovery

5.3.1 What is the mechanism that will cause the natural recovery? Is it due to gradual burial with clean sediments, in which case only the PCB availability at the sediment surface is being reduced? Is it due to dechlorination? If yes, what rate of dechlorination has been assumed? Is it due to a continuing PCB flux from the sediment into the water column and subsequent transport out of the waterway? (1)

Response: Natural recovery of PCBs at the CB/NT Site will occur primarily because of burial by clean sediments (sources include the Puyallup River sediment load and small streams entering the waterways). Dechlorination processes are extremely slow and sediment flux to water is negligible because of the binding of PCBs to sediment carbon. In assessing the potential for natural recovery of PCBs at the CB/NT Site, EPA assumed there would be no biological or chemical degradation of PCBs, and that all natural recovery would be due to burial and mixing with clean sediments.

Natural recovery is determined for surface sediment as represented by the biologically active zone (top 10 cm). This is the stratum where most of the sediment-dwelling organisms that serve as prey to fish live. Receptors of concern are not exposed to deeper sediment.

5.3.2 Use of the 1989 standards will allow for corrective measures and, based on monitoring to ensure that natural recovery is occurring, will make sure we collect all of the PCBs still trickling into the sound. (3)

Response: Regardless of which PCB cleanup level is chosen, long-monitoring of sediments will occur following cleanup to ensure that contaminant concentrations remain at acceptable levels. In addition, EPA has added a requirement to the ESD that PCB concentrations must be reduced to 300 μg/kg within ten years of the remedial action. This means that long-term monitoring of PCB-contaminated sediments will be required to ensure that this standard is met. Finally, control of ongoing sources of contamination is required under the 1989 ROD, and will continue to be an integral part of the CB/NT cleanup.

5.3.3 Since the proposed 450 μg/kg cleanup level is based on no natural recovery, EPA should not use natural recovery to assess the level of protectiveness that will be achieved by that cleanup level. (8)

Response: EPA believes it is appropriate to use natural recovery to assess the protectiveness of the remedy, because we have added natural recovery as a required element of the remedy in the ESD. In response to public comments, and those of the State, EPA has modified the remedy as proposed in the March, 1997 draft ESD (EPA, 1997a) to include a PCB cleanup standard for natural recovery. If PCB concentrations in sediments do not naturally recover to at least 300 μg/kg within 10 years after the remedial action, EPA will take additional measures to achieve this concentration. Natural recovery modeling done to date indicates that, after source control is complete and sediments are remediated to 450 μg/kg PCBs, sediment PCB concentrations will be reduced to even lower than 300 μg/kg within 10 years.

5.3.4 The ROD provides natural recovery rate estimates for the Hylebos. The HCC is required by the AOC to develop an updated natural recovery rate analysis for the Hylebos. The natural recovery rate can be used to show areas of the Hylebos that will recover to below the 450 μg/kg PCB cleanup level in ten years. EPA should not conclude that natural recovery to 450 μg/kg is not appropriate for PCBs prior to reviewing the natural recovery analysis that EPA required the HCC to conduct under the AOC. (17)

Response: EPA agrees that natural recovery should be included as part of the remedy, but disagrees that 450 μg/kg should be the 10-year standard. EPA's SRAL of 450 μg/kg PCBs is at the high end of the risk range considered acceptable to EPA. If EPA allowed for natural recovery to 450 μg/kg, PCB concentrations in the interim 10-year period would be unacceptably high. EPA did consider natural recovery in its original proposal, in the sense that we acknowledged that one of the reasons it was acceptable to select a cleanup level at the high end of EPA's risk range, was that risks would be reduced over time through natural recovery. In the final ESD, EPA has added a requirement that sediments must naturally recover to 300 μg/kg PCBs within

10 years after cleanup. This will ensure that if sediments do not naturally recover, additional cleanup work will be done to ensure that a 300 μg/kg PCB cleanup level is achieved.

5.3.5 Weston states that natural recovery will further reduce PCB concentrations in the sediment, but does not address the uncertainty associated with natural recovery itself. (35)

Response: EPA agrees that there is uncertainty associated with natural recovery estimates. A complete analysis of natural recovery potential at the CB/NT Site was not conducted for the reevaluation of the PCB cleanup level. Instead, EPA relied upon the natural recovery estimates in the 1989 CB/NT ROD.

In the revised ESD, EPA has added a requirement that sediments must naturally recover to at least 300 μg/kg PCBs. Even though EPA has not attempted to quantify uncertainties associated with natural recovery estimates, we believe an estimate of natural recovery to 300 μg/kg is conservative because it falls at the high end of the range of estimated natural recovery rates for PCBs in the Hylebos Waterway. Using natural recovery rates in the ROD, sediments are predicted to naturally recover to 280 to 225 μg/kg PCBs following cleanup to 450 μg/kg. Additional natural recovery modeling will be required as part of pre-design work to verify the estimates in the 1989 ROD.

5.4 Comments related to current contamination and source control

5.4.1 EPA has failed to produce results on controlling ongoing sources of PCBs in Commencement Bay showing an even more feeble approach to PCB cleanup. The National Marine Fisheries Service study states that the health of the bay has not improved in the last ten years. Can EPA demonstrate that the next ten years will be any better? (8)

Response: Source control activities have been ongoing at the CB/NT site since the Record of Decision was signed in 1989. Ecology is responsible for working with individual facilities to achieve source control. For the Hylebos Waterway, Ecology has inspected or investigated 141 potential sources of contamination and have identified 26 ongoing sources. Ecology has worked with each of these facilities to control their sources, either through upland cleanups or implementation of best management practices. Of the 26 ongoing sources identified by Ecology, 21 have been controlled as of July 1997. Ecology plans to have all ongoing sources of contamination controlled (except intertidal areas, as discussed below), by mid-1998.

One of the significant sources of contamination remaining in the Hylebos Waterway is the intertidal sediments. These sediments contain the highest concentrations of PCBs and other chemicals found in the waterway. These intertidal sediments will act as sources of contamination to the rest of the waterway until they are remediated. Remediation of intertidal areas will occur either as part of Ecology cleanups or as part of the overall waterway cleanup. Additionally, subtidal sediments with high concentrations of PCBs act as continuing sources of PCBs through resuspension of sediments and movement to other parts of the waterways. However, after cleanup of areas where sediments exceed EPA's cleanup levels for PCBs and other contaminants, these sources of sediment recontamination will be removed, allowing for natural recovery to occur.

The NMFS study cited in the comment addresses current contamination in the Hylebos Waterway. See response to Comment 5.4.2 for a discussion of the results of this study.

5.4.2 When recent toxicopathic results are compared to previous work done as part of the RI/FS, it is evident that conditions for flatfish (based on lesion prevalence and biochemical measures of early response to contaminant exposure) in the waterway have not measurably improved. This fact is significant as EPA is espousing a cleanup level three times higher than that originally stated in the ROD with the supporting rationale that natural recovery would be expected to occur (allegedly decreasing the concentration of PCB's in half over a 10 year period). The effects of natural recovery, since the RI data was collected (more than 10 years ago) have not been observed. (24, 8, 36)

Response: The NMFS study cited in the comment evaluates current conditions in the Hylebos Waterway. EPA agrees that those and other studies show that natural recovery has not significantly reduced PCB concentrations or toxic effects in the Hylebos Waterway in the last 10 years. However, these studies are not a good predictor of conditions in the Waterway in the 10 years after completion of the cleanup.

Many of the source control activities required by the ROD have been completed in the last three to four years, and some will be completed over the next year. As noted in the response to Comment 5.4.1, PCB-contaminated intertidal sediments, one of the major sources of PCB contamination remaining in the waterway, have not yet been remediated. Because source control is not complete and sediments containing high concentrations of PCBs have not been remediated, no appreciable natural recovery of PCBs has occurred to date in the Hylebos Waterway.

Once source control and sediment remediation is complete, conditions in the Hylebos Waterway will change substantially. The highly contaminated sediments which are currently subject to erosion and movement to other areas of the waterway will be removed and replaced by clean sediments. These clean sediments will continue to move about the waterway and further reduce contaminant concentrations in areas where low levels of PCBs were left in place, leading to an overall reduction of contaminant concentrations in the waterway. In addition, clean sediments from other sources such as Hylebos Creek and the Puyallup River will continue to enter the waterway and further reduce contaminant concentrations through burial and mixing. For these reasons, EPA believes there will be natural recovery of PCB-contaminated sediments after completion of the cleanup, even though it has not occurred in the 10 years since the ROD was signed.

5.4.3 A recent study by the National Marine Fisheries Service in the Hylebos Waterway of Commencement Bay revealed elevated levels of PCBs in fish and links the presence of PCBs to altered sexual reproduction of flatfish. Fish-eating birds, such as bald eagles and blue herons, in the Commencement Bay area have high levels of PCBs in their embryos. The herons from Dumas Bay use Commencement Bay as their feeding grounds. Seven eggs were collected from a colony of great blue herons in Commencement Bay in 1988. Chemical analysis revealed that PCB concentrations surpassed the threshold level for adverse impacts. Last year, 5 more eggs were collected from the Dumas Bay great blue heron colony, and the levels of PCBs in some of the eggs were still at levels where FWS would anticipate adverse affects. Recently, we have also determined that a significant portion of birds from this colony feed in Commencement Bay and its waterways. (35, 8, 26, 36)

Response: Please see responses to Comments 5.4.2 and 4.4.6.

5.4.4 Hasn't scientific testing shown this area to be polluted and one of the most toxic spots for the last 15 years? (9)

Response: EPA agrees that concentrations of chemical contaminants are unacceptably high at the CB/NT Site and present unacceptable risks to human health and the environment. This assessment is the basis of EPA's 1989 ROD which requires source control and sediment cleanups at eight contaminated sediment problem areas in the Commencement Bay tideflats.

5.5 Comments related to changing the ROD

5.5.1 In other EPA regions, federal courts, at the behest of EPA, give great credence to ROD numbers and the idea they should be frozen in time, otherwise a plethora of other values could be proposed and the remedial process could be thwarted. It is interesting that when potentially responsible party (PRP)-sponsored cleanup numbers come along later which are less restrictive, this theory seems to be quickly abandoned. (11)

Response: EPA has a policy of not reopening Records of Decision to incorporate regulations passed after the ROD is signed, unless necessary to ensure protectiveness, because of the potential for long delays in implementing cleanups if the basis of a remedy had to be continually reevaluated during the design and implementation phases. However, this does not mean that EPA will ignore new information which indicates that the remedy may not be cost-effective when coupled with evidence that it may be possible to dredge a smaller volume of sediments with no appreciable change in the protectiveness of the remedy.

EPA has also championed the policy of reevaluating old remedies when new information indicates that there may be a more cost-effective way to implement the cleanup. EPA will also reevaluate remedies when new information indicates that a remedy is not sufficiently protective. This is true for Superfund-financed as well as potentially-responsible-party-financed cleanups.

In addition, the new PCB cleanup number is not a PRP-sponsored number. See comments in Section 3.2 for information about PCB cleanup levels preferred by PRPs.

5.5.2 The proposed modification, requested by several potentially responsible parties, sends the wrong message — if you delay cleanup long enough, you can weaken standards and cut your liability. (28)

Response: EPA agrees that Superfund cleanups should be implemented as quickly as possible for a variety of reasons, the most important of which is to remove contamination from the environment as quickly as possible. Regardless of the length of time between development and implementation of a cleanup plan, EPA believes that it is appropriate to reevaluate a Superfund remedy if new information indicates that the original decision may be significantly flawed. This is true whether the remedy is being paid for through Superfund monies or if it is privately funded.

5.6 Comments related to the role of parties outside EPA

5.6.1 Ecology must abide by the 1989 ROD which established 150 μg/kg as the allowable level of PCBs in sediment. Will this mean a dual standard for cleanup of toxic sites in Washington State? Will a bill be submitted to the legislature demanding that state standards cannot exceed federal standards in any case? (3)

Response: The 1989 ROD for the CB/NT Site is an EPA document, with concurrence by Ecology. Ecology has also concurred with EPA's decision to modify the ROD by issuing this ESD. The PCB cleanup standards set by this ESD of 450 μg/kg immediately after cleanup and 300 μg/kg within 10 years after cleanup were developed based on the site-specific circumstances at the CB/NT Superfund site, and applies <u>only</u> to the cleanup of that site. Ecology is not required to follow the CB/NT ROD or this ESD for setting sediment cleanup levels elsewhere in the state. Ecology has not yet set numeric standards for PCBs in sediments for protection of human health and may set standards that are more or less stringent that the standard set for the CB/NT Superfund site.

5.6.2 Outside of the ecological concerns I also wondered if the state health department played any role in the PCB decisions? I am unable to find any record of their involvement or concurrence. (11)

Response: The Washington State Department of Health (WDOH) was notified that EPA was considering modifying the PCB cleanup level for the CB/NT Superfund site in February 1996, and was given the opportunity to comment on Weston's first draft evaluation of potential alternative PCB cleanup levels. WDOH's comment letter is in the Administrative Record for this ESD.

5.6.3 The businesses and the Port of Tacoma which stand to save $13 million dollars from EPA's proposal underestimate the long term impacts a decision in their favor would cause. (8)

Response: See response to Comment 5.2.2.

5.7 Comments related to the remedial action

5.7.1 We have serious reservations as to whether a remedial program for achieving the targeted cleanup level is either (1) feasible or (2) is at all predictable with regard to ultimate schedule and cost. No dredge or combination of dredges can consistently achieve a cleanup level of even several ppm. Please clarify EPA's position in this regard. (1)

Response: In general, the achievement of the cleanup level via dredging is not predominantly a function of dredging technology itself but more a function of how much contaminated material exists and how much requires removal to achieve the cleanup objective. In most areas of Commencement Bay, sediment contamination is associated with overlying unconsolidated sediments. The underlying native sediments are, with a few exceptions, relatively free of contamination. Sediment cores have been used to identify the depth of contaminated material, which in many areas is only a few feet deep. EPA's experience with the St. Paul and Sitcum Waterway cleanups in Commencement Bay shows that cleanup to the Sediment Quality Objectives in the ROD is feasible, and with sufficient sampling, is predictable with regard to schedule and cost.

5.7.2 The more than half century of industrial use of the Hylebos Waterway must have resulted in wide-spread and sizable quantities of debris disturbed and embedded on the bottom. Debris is detrimental to the efficient and continuous operation of a dredge. Debris, or rocks, was a serious problem at least four of the six Superfund sites mentioned in Comment 5.2.1. Has EPA assessed the debris problem? How would this problem be managed and overcome during the proposed dredging process? What would the disposition of the debris be? Have the substantial inefficiencies due to debris interferences, and management and disposal of debris, been included in the cost estimate? (1)

Response: During the initial investigations of the Hylebos Waterway, a side-scan sonar survey was conducted to identify the quantity and location of subsurface debris. This survey showed that there is some metal debris and some sunken logs in the Hylebos Waterway, but the extent of debris was not as great as has been seen at other

Puget Sound dredging projects. A similar survey has not yet been conducted for the Thea Foss Waterway, but we have no reason to believe there would be more debris at Thea Foss than at Hylebos Waterway.

Dredging plans have not yet been developed for either waterway. These plans will include plans for handling and disposition of debris. The presence of debris is one of the factors to be used in determining the dredging method, as use of a clamshell dredge rather than a hydraulic dredge will minimize difficulties in handling debris. Regardless of the selected dredging method, the debris will most likely be handled and disposed of separately. It is not anticipated that debris handling will significantly impact the cost of the remedy.

5.7.3 Is capping a candidate remedial technology for the Hylebos Waterway, or is the reference to capping inadvertent? Please explain the status of a capping remedy. (1)

Response: Capping is one of the sediment confinement options selected in the 1989 ROD. However, capping is only appropriate in areas where there are no or limited navigational constraints and where the cap is not likely to be disturbed through erosion, scour, or future dredging. Capping is precluded in much of the Hylebos Waterway due to these constraints. However, it is being considered for some of the intertidal areas in the Hylebos Waterway and portions of the Thea Foss Waterway.

5.7.4 The ESD acknowledges the benefit of having only one disposal site, rather than multiple disposal sites. One disposal site decreases the amount of area initially disturbed, decreases monitoring efforts, and also may decrease the likelihood of breach of containment. As pointed out in the "Explanation of Significant Differences...", pages 15 and 17, a cleanup volume greater than 700,000 cubic yards (cy) may require multiple disposal sites. Since the proposed cleanup level of 450 μg/kg would result in the removal of approximately 508,000 cy of contaminated sediments and the original cleanup level (300 μg/kg) would result in approximately 891,000 cy, it may be best to extrapolate the cleanup level based on 700,000 cy of contaminated sediment. This approach would provide a cleanup level that is more protective than the proposed 450 μg/kg concentration and yet should not increase the technical feasibility of the cleanup effort. (34)

Response: Backcalculating a cleanup level based on volume limits is an interesting idea; however, it would require a fixed volume above which we will need multiple disposal sites. Since a disposal site has neither been selected nor designed for the remaining cleanups, at this time we only have estimates of the capacities of various disposal sites which are under consideration. The figure of 700,000 cubic yards mentioned in the ESD is merely an estimate of a volume over which multiple disposal sites are likely to be needed, because most of the sites under consideration have capacities of less than 700,000 cubic yards. Waiting for selection and design of a disposal site, then calculating a PCB cleanup level based on the capacity of that site, would cause a long delay in the cleanup.

5.8 Other Comments

5.8.1 As a general concern, the documents released for public review did not address the EPA's authority to issue an explanation of significant difference. We would appreciate information on the regulatory framework for which an explanation of significance is allowed and appropriate. (8)

Response: The implementing regulations for the Superfund law are contained in the NCP, which is codified at 40 CFR Part 300. Section 300.435(c) of the NCP sets out the procedures EPA must follow if, after the ROD is adopted, new information developed during the remedial design or remedial action, or an enforcement action, or consent decree, results in the remedial action differing significantly from the remedy selected in the ROD with respect to scope, performance, or cost. The NCP requires that a summary of the explanation of significant differences be published in a newspaper of general circulation, and that the explanation of significant differences and supporting documentation be placed in the Administrative Record for public review. Significant changes to a remedy are generally changes to a component of the remedy that do not fundamentally alter the overall remedial approach. Fundamental alterations to the ROD are considered changes which make the remedy no longer reflective of the selected remedy and, therefore, require an amendment to the ROD.

In this case, information collected during pre-design sampling indicated that the volume of sediments required to cleanup up to the PCB cleanup level in the ROD was significantly larger than originally anticipated. The ROD estimated that remediation of 448,000 cubic yards of contaminated sediments would be required in the Hylebos Waterway at an estimated cost of $13.8 million. Current estimates place this volume at 891,000 cubic yards and the cost at $31 million, mainly due to new estimates of the extent of PCB contamination. This, in itself, is a significant change in the scope, performance, and cost of the ROD. With this ESD, the amount of sediment requiring remediation will change to 508,000 cubic yards, at a cost of $18 million.
The revised PCB cleanup level significantly changes a performance standard established in the ROD, but does not significantly change the volume and cost of the cleanup as anticipated in the 1989 ROD. The remedial approach remains the same as outlined in the ROD (i.e., confinement of contaminated sediments that will not naturally attenuate below the cleanup levels within 10 years). Additionally, in this case, EPA chose to go beyond what the regulations require for public review of an ESD by informing the public of our proposed PCB cleanup level and taking public comment on that proposal before making a final decision.

5.8.2 There is a connection between what you require in cleanup and pollution prevention. If you send the message with this cleanup that they can leave more there, you are sending a message to everyone that continued pollution — you may not be held accountable for continued pollution. (36)

Response: EPA agrees that the Superfund law and its requirements for cleanup of contamination send a strong message that pollution carries with it a high cost. With the PCB SRAL set at 450 μg/kg, PRPs will be required to dredge approximately 500,000 cubic yards of sediments at a cost of $18 million for the Hylebos Waterway. Polluters are still getting a message that there is a significant cost associated with pollution of the CB/NT Superfund site.

5.8.3 I am also concerned as to how these levels may be used in negotiations with potentially responsible parties to lessen the footprint of contaminated sites, thereby reducing damage assessment calculations. (11)

Response: Natural Resource Trustees assess damage to natural resources independently of EPA's efforts to define a cleanup area. EPA's selection of a PCB cleanup level and associated footprint of a cleanup area should not affect the Trustee's ability to recover costs for damage to natural resources.

5.8.4 This action by EPA appears to be cost driven, with little publicity, an abbreviated response time, and limited participation. Tahoma Audubon Society did not receive a notice and there was no published notice in the News Tribune, leading me to wonder how wide the contact was. I believe that one newspaper article appeared on the subject. Finally two weeks from the public hearing to the response deadline is a very short time for such a complex subject. (3)

Response: EPA's efforts to inform and involve the public in this decision are described on page 2 of this responsiveness summary. EPA sent fact sheets to over 2,000 people to announce a 30-day public comment period on the proposed ESD, which ran from March 10 through April 9, 1997. On March 10th, the beginning of the comment period, a display advertisement was placed in the *Tacoma News Tribune* announcing EPA's proposal, the comment period, and the date of the public meeting, which was held on March 26. These efforts are consistent with or greater than EPA's practice at other Superfund sites.

EPA has added this commentor to our Commencement Bay mailing list. Others who would like to be on EPA's mailing list to receive fact sheets on the CB/NT Site, are welcome to contact Jeannie O'Dell at (206) 553-6919 to ask to be added to the mailing list.

Part III—List of Commentors

HYLEBOS PCB COMMENT SUMMARY RESPONDENTS

Abbreviated Reference	Full Reference
1	Applied Environmental Management, Inc.
2	Agency for Toxic Substances and Disease Registry
3	Tahoma Audubon Society
4	Bay Zinc Company, Inc.
5	Bonneville Power Administration
6	Graham & James LLP/Riddell Williams P.S. representing the Buffelen Woodworking Company
7	Byrd Real Estate Services, Inc.
8	Citizens for a Healthy Bay
9	Individual Citizens
10	City of Tacoma
11	Washington Department of Ecology (as Natural Resource Trustee)
12	Washington State Department of Health
13	Dunlap Towing Company
14	Floyde & Snider, Inc.
15	F.O.F., Inc.
16	Gradient Corporation
17	Hylebos Cleanup Committee
18	Hylebos Marina
19	Manke Lumber Company
20	Mintercreek Development
21	Modutech Marine, Inc.
22	Murray Pacific Corporation
23	Middle Waterway Action Committee
24	National Oceanic and Atmospheric Administration
25	PALS Investments
26	People for Puget Sound
27	Petroleum Reclaiming Service, Inc.
28	Puget Soundkeeper Alliance
29	Puyallup Tribe of Indians

HYLEBOS PCB COMMENT SUMMARY RESPONDENTS

Abbreviated Reference	Full Reference
30	Joseph Simon & Sons
31	Steich Brothers Machine Works
32	Bucknell Stenlik representing Taylor Way Properties, Inc.
33	Tacoma Pierce County Chamber of Commerce
34	Tacoma-Pierce County Health Department
35	U.S Fish and Wildlife Service
36	Washington Toxics Coalition

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E. GLOSSARY OF TERMS

Apparent Effects Threshold: A chemical concentration above which deleterious biological effects are predicted to always occur.

Arithmetic mean: In testing, the same as ordinary average determined by adding all the scores and dividing the sum by the number of scores in the group. The resulting quotient is the average or mean.

Aroclors: Industrial mixtures of polychlorinated biphenyl compounds.

Bathymetry: A topographic map of the bed of the ocean.

Biomagnification factor (BMF): A factor describing the degree of accumulation of an organic chemical taken up from an environmental medium in a living organism.

Biota-sediment accumulation factor (BSAF): A factor describing the rate of transfer of an organic chemical from sediment to an organism.

Cancer slope factor (CSF): A term used to describe the adverse cancer effects of a contaminant. CSFs are measured by the probability of a person developing cancer over a lifetime.

Endocrine disrupter: An agent that interferes in some way with the natural hormones in the body (e.g., those secreted by the pituitary, thyroid, pancreas, adrenal, testes and ovaries). An agent might disrupt the endocrine system by affecting any of the various stages of hormone production and activity.

Geometric mean: That value obtained by multiplying all the items of a series together and extracting the *nth root* of this product, where *n* is the number of items.

Hazard quotient: A ratio comparing a chemical concentration in an environmental medium (e.g., sediment) to a toxicity threshold value or criterion. A result greater than 1 indicates an exceedance of the threshold or criterion.

K_{ow}: A laboratory measure of the partitioning of a chemical between *n*-octanol and water. It provides a measure of the water solubility of a chemical.

Lognormal: A statistical distribution of an environmental variable (e.g., chemical concentration) in which lower values are more frequently encountered. The central tendency (or middle) of the distribution tends to be lower than that estimated by an arithmetic mean and is often estimated by the geometric mean.

Microtox: A commercial bioassay test measuring changes in bioluminescence in a bacterium in response to contaminant exposure.

Organic carbon normalized: Expression of a dry-weight chemical concentration in terms of parts of organic carbon. Derived by dividing a chemical concentration by the decimal fraction of organic carbon in the sediment.

Parts per Billion (ppb): Parts of a chemical (e.g., PCBs) per billion parts of an environmental medium (e.g., fish tissue). May be expressed as μg/kg.

Parts per Million (ppm): Parts of a chemical (e.g., PCBs) per million parts of an environmental medium (e.g., fish tissue). May be expressed as mg/kg.

Pathogens: Microorganisms that can cause disease in other organisms or in humans, animals and plants (e.g., bacteria, viruses, or parasites) found in sewage, in runoff from farms or rural areas populated with domestic and wild animals, and in water used for swimming. Fish and shellfish contaminated by pathogens, or the contaminated water itself, can cause serious illness.

Potentially responsible parties (PRPs): Any individual or company—including owners, operators, transporters or generators-potentially responsible for, or contributing to, a spill or other contamination at a Superfund site.

Reasonable maximum exposure (RME): The highest exposure reasonably expected to occur in a population.

Reference dose (RfD): The concentration of a chemical known to cause health problems; also can be referred to as the ADI, or acceptable daily intake.

Total organic carbon: Carbon derived from a living or decomposing material that has been incorporated into a sediment matrix.

Trophic level: A step along the food chain from numerous small organisms to decreased numbers of large organisms.

μg/kg: Micrograms of a chemical (e.g., PCBs) per kilogram of an environmental medium (e.g., fish tissue); also expressed as parts per billion or ppb.

mg/kg: Milligrams of a chemical (e.g., PCBs) per kilogram of an environmental medium (e.g., fish tissue); also expressed as parts per million or ppm.

EXPLANATION OF SIGNIFICANT DIFFERENCES
COMMENCEMENT BAY NEARSHORE/TIDEFLATS SUPERFUND SITE

August 2000

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EXPLANATION OF SIGNIFICANT DIFFERENCES
COMMENCEMENT BAY NEARSHORE/TIDEFLATS SUPERFUND SITE

August 2000

I. INTRODUCTION

A. Site Name and Location

The Commencement Bay Nearshore /Tideflats (CB/NT) Superfund site is located in Tacoma, Washington, at the southern end of the main basin of Puget Sound (Fig. 1). This Explanation of Significant Differences (ESD) describes the cleanup plans for the Thea Foss, Wheeler-Osgood and Hylebos waterways and identifies the disposal sites being selected to contain dredged contaminated sediments from Thea Foss (formerly City) and Wheeler-Osgood, Hylebos, and Middle waterways. The cleanup plan for Middle Waterway will be outlined in a separate ESD in the fall of 2000.

B. Lead and Support Agencies

U.S. Environmental Protection Agency (EPA) – Lead Agency for Sediment Remediation

Washington State Department of Ecology (Ecology) - Lead Agency for Source Control; Support Agency for Sediment Remediation

Puyallup Tribe of Indians - Support Agency for Sediment Remediation

C. Statutory Authority

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 117(c) and National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Section 300.435(c)(2)(i).

D. Purpose

EPA's September 30, 1989 Record of Decision (ROD) for the CB/NT Superfund site selected a remedy involving a combination of five key elements: site use restrictions (now commonly referred to as institutional controls), source control, natural recovery, sediment remedial action (i.e., confinement and habitat restoration), and monitoring, to address contaminated sediments in the waterways of the CB/NT site. This ESD describes the specific manner in which the ROD is being implemented at these individual waterways and points out the significant differences between the ROD and the cleanup plans described in this ESD. The ESD will: (1) describe the remedial actions consistent with the ROD to clean up contaminated sediments in the Thea Foss, Wheeler-Osgood, and Hylebos waterways of the CB/NT Superfund site; and (2) identify disposal sites that will be used to contain the contaminated sediments to be dredged from Thea Foss, Wheeler-Osgood, Hylebos, and Middle waterways.

II. BACKGROUND

A. Site History

The CB/NT Superfund site is located in Tacoma, Washington at the southern end of the main basin of Puget Sound (Fig. 1). The site includes 10-12 square miles of shallow water, shoreline, and adjacent land, most of which is highly developed and industrialized. The upland boundaries of the site are defined according to the contours of localized drainage basins that flow into the marine waters. The marine boundary of the site is limited to the shoreline, intertidal areas, bottom sediments, and water of depths less than 60 feet below mean lower low water level (MLLW). The nearshore portion of the site is defined as the area along the Ruston shoreline from the Mouth of Thea Foss Waterway to Pt. Defiance. The tideflats portion of the site includes the Hylebos, Blair, Sitcum, Milwaukee, St. Paul, Middle, Wheeler-Osgood, and Thea Foss waterways; the Puyallup River upstream to the Interstate-5 bridge; and the adjacent land areas.

In 1996, EPA deleted the St. Paul Waterway, the Blair Waterway, and all or part of four properties transferred to the Puyallup Tribe in the Puyallup Land Settlement Agreement from the National Priorities List (NPL) because cleanups had been completed in these areas, or studies had been completed showing that they did not require cleanup.

EPA placed the CB/NT site on the NPL of sites requiring investigation and cleanup under EPA's Superfund Program on September 8, 1983. A remedial investigation/feasibility study (RI/FS) was completed by Ecology in 1988. EPA made the final RI/FS available for public comment in February 1989. The RI/FS evaluated contaminants detected in sediments at the CB/NT Superfund site to identify problem chemicals that pose a risk to human health and the environment. The RI/FS concluded that sediments in the nearshore/tideflats area were contaminated with a large number of hazardous substances at concentrations greatly exceeding those found in Puget Sound reference areas. In the RI, a multi-step decision-making process was used to identify problem chemicals, and to identify and prioritize problem areas where these chemicals were present at concentrations that are harmful to humans and wildlife.

Contaminants found at elevated levels in the Thea Foss and Wheeler-Osgood waterways included zinc, lead, mercury, high molecular weight polycyclic aromatic hydrocarbons (HPAHs), low molecular weight polycyclic aromatic hydrocarbons (LPAHs), cadmium, copper, nickel, 2-methylphenol, 4-methylphenol, bis[2-ethylhexyl] phthalate (BEP), butyl benzene phthalate, and polychlorinated biphenyls (PCBs). In addition, non-aqueous phase liquid (NAPL) seeps have been found at the head of the Thea Foss Waterway. The most severely contaminated sediments at Hylebos Waterway had high concentrations of several chlorinated organic compounds (including

PCBs. pesticides, hexacholorbenzene and hexachlorobutadiene), HPAHs, LPAHs, lead, copper, zinc, mercury, and arsenic. Mercury and copper were identified as indicator chemicals of severe sediment contamination in Middle Waterway.

B. Commencement Bay Nearshore/Tideflats Record of Decision

The Commencement Bay site has been divided into smaller project activities, called operable units (OU), in order to more effectively manage the overall cleanup of the site. In the 1989 ROD, EPA designated two operable units for the cleanup of the nearshore/tideflats portion of Commencement Bay: source control (OU 5), which focuses on efforts to control upland discharges or releases to the Bay; and sediment remediation (OU 1), which addresses the cleanup of the contaminated marine sediments in Commencement Bay. The Washington Department of Ecology is the lead agency for source control and EPA is the lead agency for sediment remediation. OUs 2-4 and 6 address contamination at geographically separate areas at the former ASARCO smelter and Tacoma Tarpits.

In the ROD, EPA selected a remedial action for eight of the nine sediment problem areas identified through the RI/FS process as being the most significantly contaminated areas. These problem areas are: 1) Mouth of Hylebos Waterway, 2) Head of Hylebos Waterway, 3) Sitcum Waterway, 4) St. Paul Waterway, 5) Middle Waterway, 6) Head of Thea Foss Waterway, 7) Mouth of Thea Foss Waterway, and 8) Wheeler-Osgood Waterway. The ninth problem area, off-shore of the ASARCO smelter (OU 6), is being addressed in a separate ROD. To date, remedial actions consistent with the CB/NT ROD have been completed at the Sitcum and St. Paul waterways. (The St. Paul Waterway cleanup occurred at a different location than the St. Paul Nearshore Fill selected in this ESD.)

The cleanup objective for the remedial action, as described in Section 10 of the 1989 ROD, states that "the selected remedy is to achieve acceptable sediment quality in a reasonable time frame." "Acceptable sediment quality" is defined as "the absence of acute or chronic adverse effects on biological resources or significant human health risks". The ROD designated biological test requirements and associated sediment chemical concentrations referred to as sediment quality objectives (SQOs) to attain the cleanup objective for the CB/NT site. The PCB SQO was subsequently updated in a 1997 ESD. Habitat function and enhancement of fisheries resources were also identified as overall project cleanup objectives.

The ROD selected a remedy comprised of five key elements: site use restrictions (now commonly referred to as institutional controls), source control, natural recovery, sediment remedial action (i.e., confinement and habitat restoration), and monitoring, to address contaminated sediments in the waterways of the CB/NT site.

The ROD noted that institutional controls would consist primarily of public warnings to reduce potential exposure to site contamination, particularly of contaminated seafood. The

Tacoma/Pierce County Health Department has installed signs at several locations in the CB/NT waterways providing warnings in several languages against eating seafood caught there.

The objectives under source control are to control major sources of contamination to the waterways prior to implementation of active remediation in the waterways and to monitor source control effectiveness both prior to and after completion of sediment remedial action.

For marginally contaminated areas expected to recover naturally to the SQOs within 10 years after sediment remedial action, the ROD calls for natural recovery. For areas that are not expected to recover within a 10-year time frame, the ROD specified that active remediation of problem sediments would be accomplished by utilizing a limited range of four confinement technologies. These technologies are in-place capping, confined aquatic disposal, nearshore disposal, and upland disposal.

Long-term monitoring of the remediated areas, including disposal sites and habitat mitigation areas, is also a component of the remedy. Monitoring will be conducted to evaluate the effectiveness of the remedy in achieving SQOs and in achieving the habitat functions that are called for in the mitigation plans.

C. Analysis of Treatment Technologies

The ROD also concluded that the selected remedy described above represented the maximum extent to which permanent solutions and treatment technologies could be utilized in a cost-effective manner at the CB/NT site. To determine whether the ROD's conclusion about treatment technologies was still valid at this time, EPA Region 10 asked EPA's National Risk Management Research Laboratory in Cincinnati, Ohio to review site-specific data that have been generated at the three waterways since the ROD, and to provide Region 10 with an opinion about the viability and cost-effectiveness of currently available treatment technologies.

EPA's conclusion is that while some new treatment technologies are available, most are still in the pilot stage, and all would be more expensive than the most expensive confined disposal option, upland disposal. The wide-spread, low level sediment contamination present in much of Commencement Bay is not the optimal scenario for applying a treatment technology, which generally works best when applied to low volume, highly concentrated waste. At this time, confinement remains the best option for the contaminated sediments being addressed under the 1989 ROD and this ESD.

Treatment may be used, however, to address localized "hot spot" areas in the Hylebos and Thea Foss waterways. This includes some of the contaminated materials found near the former Occidental Chemical facility on the Hylebos Waterway, which is being addressed under a separate CERCLA response action (see Section V), and potentially NAPL at the head of the Thea Foss Waterway. In general, NAPL is considered a "principal threat" source material. EPA expects that treatment be used to address principal threats wherever practicable. The decision to treat principal threat materials, however, is made on site-specific basis. EPA has determined that containment is the most appropriate option for the NAPL at the head of Thea Foss Waterway. Some NAPL, however, will be excavated as needed for construction of the cap and may require treatment prior to disposal (see Section V). The need for treatment prior to disposal will be determined by further testing during the remedial design phase.

III. DESCRIPTION OF AND BASIS FOR THE SIGNIFICANT DIFFERENCES

A. Introduction

The CB/NT ROD sets forth a general cleanup approach for the waterways that comprise the CB/NT site and identifies, based on RI/FS sampling data, problem areas requiring response action. Since then, pre-remedial design studies at the individual waterways have better defined the area and volume of sediment exceeding the SQOs, and identified specific areas to be dredged or capped, as well as areas where natural recovery would be appropriate. In addition, the post-ROD studies helped EPA identify which disposal sites (nearshore, in-water, and upland) would be most appropriate to safely contain dredged sediments.

Consequently, this ESD documents the following changes:

a) the size of the problem areas and the volume of sediment to be dredged,
b) institutional controls related to contaminated sediments contained on-site,
c) addition of an option to use a thin layer of clean material to allow marginally contaminated sediments to naturally recover, (i.e. "Enhanced Natural Recovery"),
d) additional specificity of remedial actions for the Thea Foss, Wheeler-Osgood, and Hylebos waterways,
e) elaboration of performance criteria for the cleanup plans,
f) inclusion of the Endangered Species Act (ESA) as an applicable, or relevant and appropriate, requirement (ARAR) for remedial actions under the ROD, and
g) the cost of the remedial action.

While these are significant changes, the cleanups that are described in this ESD are fundamentally consistent with the remedy set forth in the 1989 ROD. The ROD selected natural recovery or confinement as the primary methods for addressing contaminated sediments at the CB/NT site. This ESD identifies natural recovery areas and the areas that require dredging and confinement or capping. The ROD also set forth the types of disposal sites that may be suitable to contain contaminated sediments. Consistent with the ROD, this ESD identifies the locations that will be used as disposal sites. None of the significant differences discussed below fundamentally alter the remedy selected in the ROD.

B. Volume

The ROD recognized that the estimated volume of sediments needing active remediation (i.e., confinement via dredging and disposal or in-situ capping) would be refined during the remedial design phase and that both volume and costs "are anticipated to change accordingly." Since the ROD was signed, additional investigations and studies were undertaken by the potentially responsible parties (PRPs) at each of the three waterways. Those studies have resulted in the identification of higher volumes of sediment that are the subject of remedial action than was originally estimated in the ROD. The increase in contaminated sediment volumes is due to: 1) extensive remedial design sampling, which showed larger areas of contamination than were identified during the limited RI/FS sampling effort; and 2) refinement of natural recovery models in the design phase, which showed a smaller area would achieve SQOs over 10 years through natural recovery than had been estimated during the RI/FS. A comparison of the volume estimates in the ROD with the refined volume estimates in this ESD is provided in Table 1.

Table 1. Comparison of 1989 ROD and 2000 ESD volume estimates

	1989 ROD volume estimate	**2000 ESD volume estimate**
Hylebos	448,000 cubic yards (cy)	940,000 cy*
Middle	57,000 cy	75,000 cy
Thea Foss/Wheeler Osgood	437,000 cy	620,000 cy
Total	**942,000 cy**	**1,635,000 - 1,835,000 cy**

*Confined disposal of an estimated additional 120,000 cy may be needed if additional navigational dredging by the U. S. Army Corps of Engineers (Corps), the Port of Tacoma, and private parties is conducted (see Section V).

In addition to the disposal volumes for the Thea Foss Waterway, 32 acres will be capped; 4 acres will receive a minimal cap to enhance natural recovery; and 21 acres will be monitored to confirm that natural recovery is achieving sediment quality objectives in the required 10 year time frame. At the Hylebos Waterway, the estimated disposal volume includes 11.6 acres in isolated intertidal or under dock/structure areas. If the remedial design shows that those areas can be capped, it would reduce the disposal volume from 940,000 cy to 845,000 cy. Twenty (20.7) acres are identified as natural recovery areas. Refinement of dredge volumes and estimates of capping and natural recovery areas for Middle Waterway will be addressed in a separate ESD.

C. Institutional Controls

The 1989 ROD noted that institutional controls would consist primarily of public warnings to reduce potential exposure to site contaminants, particularly contaminated seafood. Informational and advisory controls, such as fishing and fish consumption notices will continue to be used as long as it takes for fish to lose their contaminant body burdens or be replaced by younger, healthy fish that have not been exposed to contaminants.

To increase the long-term protectiveness of the waterway cleanups, institutional controls are required to meet the following objectives:

1. reduce potential exposure of marine organisms to contaminated sediments disposed of and confined in aquatic disposals sites or confined by capping; and
2. reduce potential exposure to marine organisms to contaminated sediments left on the CB/NT site.

The ROD anticipated that other regulatory programs would address contaminated sediment exposed due to navigational dredging or dredging conducted for development purposes, such as permitting requirements under Section 404 of the Clean Water Act and the state Shoreline Management Act. Thus, institutional control mechanisms that will be used to achieve the objectives stated above include governmental controls, such as local, state, and federal regulatory permitting/approval processes for dredge and fill projects in the waterways, city zoning ordinances that limit site use, or other types of governmentally required best management practices regarding maintenance activities in the waterway and removal and placement of in-water pilings. Additionally, parties constructing and maintaining the disposal sites must agree to maintain the disposal sites so as to prevent contaminated sediments from migrating or becoming exposed. Owners and/or operators of any disposal sites must ensure that any uses made on the top of the disposal site will not disturb the integrity of the disposal site or cause or contribute to the exposure of contaminated sediments to the environment. Other institutional controls may be used on a property-specific basis if determined necessary and feasible, including proprietary controls relying on real property interests, such as environmental easements and land use restrictions.

D. Natural Recovery and Enhanced Natural Recovery

The ROD identified natural recovery as an important component of the overall remedy. The expectation is that in some areas, the natural processes of sedimentation, chemical degradation, and surface sediment mixing due to bioturbation will allow contaminated sediments to recover to SQOs within 10 years after cleanup. Areas with marginally contaminated sediments that were expected to recover naturally to SQOs within 10 years after sediment remedial action would be initially exempt from sediment remedial action. Monitoring to confirm the long-term effectiveness of natural recovery is required under the ROD, and the need for active sediment remediation will be reconsidered if subsequent monitoring data indicates that natural recovery is not viable in a reasonable timeframe.

In this ESD, EPA is adding a component to help accelerate the natural recovery process. In certain locations, natural recovery will be enhanced through the application of a thin layer of clean material in specific areas of marginal contamination. This method is being referred to as Enhanced Natural Recovery. The application of minimal volumes of clean material speeds up the natural sedimentation at the outset and enhances the recovery of bottom-dwelling animals in surface sediments, which aids in building a larger base of clean material that will cover the marginally contaminated sediments.

E. Disposal Sites

The ROD did not select specific disposal sites for contaminated sediments. This ESD selects two in-water disposal sites (St. Paul Nearshore Fill, and Blair Slip 1) and upland disposal in a regional landfill, consistent with the four confinement options considered acceptable under the ROD. See Section VI.

F. Specific Cleanup Plans for the Thea Foss, Wheeler-Osgood, and Hylebos Waterways

Consistent with the ROD, this ESD describes the specific cleanup plans for Thea Foss, Wheeler Osgood, and Hylebos waterways. See Section V.

G. Performance Criteria for the Cleanup Plans

Consistent with the ROD, this ESD describes the specific performance criteria that the cleanup plans must meet to ensure that the cleanup is protective of human health and the environment. See Section IV.

H. Protection of Endangered Species

ESA is an action-specific and location-specific ARAR for the response actions under the ROD. The recent listing of Puget Sound chinook salmon and bull trout as threatened species under ESA has emphasized the need for EPA to work with the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), the other natural resource agencies, and Native American tribes to evaluate habitat impacts and habitat enhancement opportunities on a bay-wide basis.

Conservation and recovery of listed species has been an important consideration in approving cleanup plans and selecting disposal sites. Consistent with the ROD cleanup goal of enhancing habitat function and fisheries resources, EPA, Washington Department of Natural Resources (DNR), and the City of Tacoma hired a fisheries biologist from the University of Washington to conduct a bay-wide habitat assessment, *Commencement Bay Aquatic Ecosystem Assessment* (Simenstad, 2000). The assessment, discussed in Section IV.F., identifies habitat concerns associated with in-water disposal sites and incorporates effective salmon recovery components into EPA's cleanup decisions. These components have been incorporated into EPA's requirements for mitigation under Section 404 of the Clean Water Act.

EPA has prepared a biological assessment of the impacts the remedial actions in this ESD will have on the threatened or endangered species and has submitted it to NMFS and USFWS. The assessment is also included in the administrative record for this ESD. EPA's assessment has concluded that performance of the remedial actions together with all of the mitigative measures that will be required is not likely to jeopardize the continued existence of any federally listed or threatened or endangered species or result in the destruction or adverse impacts to critical habitat for these species. EPA will continue to consult with NMFS and USFWS on these cleanup plans. The consultation process may result in adjustments to mitigation plans and remedial action plans to ensure protection of endangered species and their habitat during the construction of the remedy.

I. Costs

The 1989 ROD provide a range of cost estimates for dredging contaminated sediments and disposal by confined aquatic disposal, nearshore disposal, or upland disposal. Table 2 provides a comparison of the cost estimates in the 1989 ROD to the estimates for implementing the remedial actions outlined in this ESD.

Table 2. Comparison of cost estimates in the 1989 ROD and the 2000 ESD

	1989 ROD cost estimate ($ million)	**2000 ESD cost estimate ($ million)**
Hylebos Waterway	$10.7 - $30.9	$46.1
Thea Foss/Wheeler Osgood	$8.89 - $26.7	$35
Middle Waterway	$2.66 - $7.47	no new estimate

The original ROD cost estimates were based on a smaller volume of sediment to be dredged, as shown in Table 1. The low end of the 1989 ROD cost range represents disposal in a nearshore fill that was associated with a permitted development project. There are some differences in the assumptions used to develop cost estimates in the 1989 ROD and in this ESD. For example, the ROD assumed that site preparation costs for nearshore fills would be absorbed by the developer of the commercial development project. In this ESD, cost estimates include the larger, estimated volume of sediments that require remedial action, and the cost of disposal in the selected disposal sites, including site preparation costs. For both the St. Paul Nearshore Fill and Blair Slip 1 disposal sites, the fill projects would create additional upland property, which will be beneficially used by the landowners. Economic benefits from development of new upland properties have not been taken into account in these cost figures.

For the purposes of providing cost estimates, EPA has assumed that Thea Foss and Wheeler Osgood sediments will be disposed of in St. Paul Waterway and Hylebos Waterway sediments will be disposed of in Blair Slip 1 and the Upland Regional Landfill, based on cleanup options developed by the Thea Foss and Hylebos PRPs. EPA supports this mix but reserves the flexibility to allow the PRPs to make adjustments during design based on final disposal capacity, volumes, and timing. Also, as noted in Section VI (Disposal Sites), EPA will continue to explore expanding the capacity of both the Blair Slip 1 and St. Paul Waterway disposal sites, and using contaminated sediments as upland industrial fill, which if implemented, would lower the volume of sediments requiring disposal in a regional landfill and be expected to reduce cleanup costs. Current cost estimates based on increased volumes of sediment to be dredged are provided in

Appendix A and are summarized below. Costs for Middle Waterway will be refined in a separate ESD.

Hylebos Waterway

Total remediation cost is estimated at $46,137,000 for dredging 940,000 cy of contaminated sediments from the Hylebos Waterway and disposing of 640,000 cy at the Blair Slip 1 disposal site and 300,000 cy at an Upland Regional Landfill. Cost estimates do not include land acquisition or leasing costs that may be related to use of Blair Slip 1 or with dewatering facilities associated with upland disposal. Detailed cost estimates are provided in the Hylebos Pre-Remedial Design Evaluation Report (1999), and in Appendix A of this ESD.

Thea Foss and Wheeler-Osgood Waterways

Total remediation cost for the Thea Foss and Wheeler-Osgood waterways is projected at $35,000,000. Detailed cost estimates are provided in Appendix N-9 of the "Round 3 Data Evaluation and Pre-Design Evaluation Report"and in Table A-3 of this ESD. These detailed cost estimates include the cost of a slurry wall at the head of the Thea Foss waterway, which has been excluded from EPA's selected remedy. Exclusion of the slurry wall reduces the cost from $35.9 to approximately $35 million.

A significant proportion of the total cost is attributed to remediating the head of the Thea Foss (from approximately the SR-509 bridge to the south end of the waterway). If the City's approach for remediation cannot meet specific performance criteria as discussed below then the remedy for the head of the waterway may need to be modified. Modifications may include additional source removal and/or alteration of the cap design or other possible modifications. Consequently, the remediation costs for the head of Thea Foss Waterway may change and thereby result in changes to the total remediation costs.

The following sections IV-VII provide further detail on performance criteria, the specific cleanup plans for Thea Foss, Wheeler-Osgood, and Hylebos waterways, the selected disposal sites for dredged contaminated sediments, and the status of source control actions.

IV. PERFORMANCE CRITERIA FOR THE REMEDIAL ACTIONS

While this ESD describes the remedial actions for the individual waterways with some degree of specificity, remedial design will further refine the details of the remedial actions that will be implemented in the individual waterways. In this ESD, EPA is setting forth performance criteria to be applied for the design and implementation of the cleanup. These performance criteria are consistent with the fundamental cleanup objectives set forth in the ROD and are necessary to ensure that the remedy is protective of human health and the environment, and complies with ARARs. Additional performance criteria will be identified during remedial design.

A. Cap Requirements

One of the remedial actions selected in the 1989 ROD and in this ESD is capping. EPA intends to maintain the integrity and effectiveness of caps over contaminated sediments through requirements for construction, long-term monitoring, and maintenance, including the following:

1) Caps will have a minimum thickness of three feet and will be constructed to address adverse impacts through four primary functions:
    a) Physical isolation of the contaminated sediment from the ecological receptors:
    b) Stabilization of contaminated sediments, preventing resuspension and transport to other locations within the waterway;
    c) Reduction of contaminants transported through the groundwater pathway to levels that will not recontaminate surface sediments (defined as the "biologically active zone" where most sediment-dwelling organisms live) above the SQOs or adverse biological effect levels, or contaminate surface water at levels exceeding background concentrations or marine chronic water quality criteria;
    d) Provide a cap surface that promotes colonization by aquatic organisms.

2) Long-term monitoring of the cap will include, as appropriate, visual inspection, bathymetric survey, sediment deposition monitoring, chemical monitoring, and biological monitoring.

B. Dredging and Confined Disposal

Performance standards for dredging and confined disposal will be consistent with Clean Water Act and Rivers and Harbors Act requirements. Specific details will be developed during project design. Both the remediated waterways and the disposal sites will be subject to long-term monitoring to ensure that the selected remedy remains protective, including monitoring to ensure that surface sediments do not become recontaminated in the remediated waterways, and that marine chronic water quality standards or background concentrations are not exceeded in surface water outside of the confined disposal sites.

C. Natural Recovery and Enhanced Natural Recovery

Natural recovery or enhanced natural recovery is an acceptable remediation approach at locations where sediments are marginally contaminated and are likely to recover to cleanup levels within the 10 year time frame specified in the ROD. At the CB/NT site, EPA considers marginally contaminated sediments as those with chemical concentrations less than the second lowest Apparent Effects Threshold (AET) value (the SQO is set at the lowest AET) or biological test results that do not exceed the minimum cleanup level (MCUL) values under Washington State Sediment Management Standards. Leaving highly contaminated sediments unaddressed for 10 years after remedial action would create an unacceptable short-term environmental risk, even if these sediments are predicted to naturally recover.

Areas selected for natural recovery (including enhanced natural recovery) will require: (1) monitoring plans, (2) triggers for initiating contingent actions if the monitoring indicates natural recovery will not succeed in the 10 year time frame, and (3) contingent plans for active remediation if monitoring in interim years indicates natural recovery will not occur by year 10.

D. Subsurface Contamination

In some areas where the surface sediments meet "no action" or natural recovery criteria, subsurface sediments are significantly contaminated at depth. The ROD states that SQOs must be met at the time of cleanup (or in 10 years, for natural recovery areas) and in the long-term. In order to meet SQOs in the long term, subsurface sediments must either meet SQOs or be isolated from the surface. Exposure of contaminated subsurface sediments may occur during the cleanup by dredging adjacent areas, through physical processes, such as storms or ship scour, or through future dredging or excavation. In order for subsurface contamination to remain in place, it must either be present at such low levels that it would not present a risk if it were exposed, or it must have a very low potential for exposure. These criteria have been applied in selecting the cleanup plans included in this ESD. These criteria must continue to be applied throughout the design and construction phases of the remediation. If contaminated sediments must be disturbed, for example, to accommodate a new future use, they must be handled in an environmentally responsible fashion and the newly exposed surface must meet SQOs. Either existing regulatory programs or other specific institutional controls described in this ESD will be used, as appropriate, to ensure that SQOs are met.

E. Source Control in the Thea Foss Waterway

Toward the head of the Thea Foss Waterway, municipal stormwater discharges, marinas and highly contaminated subsurface NAPL, both in the waterway and in adjacent uplands, pose a risk of recontamination of surface sediments above SQOs. If further source control actions are not taken, BEP and PAHs are predicted to recontaminate sediments in the waterway after sediment cleanup.

Ecology is working with various parties to complete source control actions in upland areas around the head of the waterway including the area near the west bank NAPL seep. This work is being done under the Model Toxics Control Act (MTCA) and the Clean Water Act.

In the "Round 3 Data Evaluation and Pre-Design Evaluation Report, Appendix U," the City of Tacoma recommended a specific in-water remedial action for the head of the Thea Foss Waterway to address the in-water NAPL contamination and seeps. Based on a subsequent technical memorandum (Technical Memorandum from Hart Crowser to Mary Henley, City of Tacoma, dated June 14, 2000) the City of Tacoma modified their recommended approach.

The City's modified approach for remediation is acceptable to EPA. In the design phase and prior to remedial action, however, the following specific performance criteria for source control and the remedy for the head of the waterway must be met to eliminate or reduce the potential for recontamination from storm drains as well as from the NAPL beneath the sediments and in adjacent uplands.

1) An approved stormwater action plan which includes, at a minimum, the following:
   a) an Ecology-approved stormwater sampling and analysis plan which will complete the Stormwater Management Plan for Thea Foss as required under the general NPDES permit,
   b) a phthalate study for determining possible phthalate sources to the Waterway,
   c) pilot testing to determine the contribution of dissolved versus particulate contaminant loading to the Waterway,
   d) an evaluation of stormwater structural controls, and
   e) an implementation schedule for the above stormwater studies, plans and controls.

2) A final remedial design based on modeling and treatability studies, and other appropriate studies, that conclusively determine that NAPL in the waterway will be stabilized and prevented from migrating to other portions of the waterway and from recontaminating surface sediments. In addition to the cap performance requirements discussed at Section IV.A. above, the sorbent cap must at a minimum also meet the following requirements:
   a) The final design of the cap must demonstrate that hydraulic control can be achieved in order to prevent remobilization of NAPL within the waterway.
   b) The final design must demonstrate that it prevents recontamination from any source material below the cap.
   c) The cap must require minimal maintenance.
   d) NAPL stabilization should include removal of contaminant source material where necessary for effective confinement.

EPA will require additional source removal and/or modification of the cap design if these performance criteria cannot be met by the City's remedial design and implementation.

F. Mitigation

Throughout pre-remedial design planning, EPA has identified all appropriate and practicable steps to avoid short- and long-term unacceptable adverse impacts to the Commencement Bay aquatic environment. All appropriate measures will be taken during remedial design, construction, and site maintenance to continue to avoid and minimize adverse impacts. Such measures that will be required by EPA include, but are not limited to, avoidance of fish-critical activity periods for in-water work, incorporation of "best-design" features and/or materials into remedial and compensatory mitigation plans that protect or enhance ESA-listed species, and creation or restoration of critical salmonid habitat. Additionally, EPA will require detailed compensatory mitigation plans to offset loss and other impacts to aquatic habitat and meet ESA responsibilities.

In assessing suitable compensatory mitigation measures, EPA has and will continue to rely upon the framework for the Commencement Bay-wide conservation and recovery strategy in the *Commencement Bay Aquatic Ecosystem Assessment* (Simenstad, 2000), along with data developed during consultation with NMFS and USFWS. The strategy of the Simenstad report focuses on broad landscape attributes and ecosystem processes (i.e., landscape ecology) that promote juvenile salmon utilization of existing and potential Puyallup River delta and Commencement Bay habitats. While the report does not specify or set priorities on discrete actions, it does identify criteria to guide selection of sites and actions. It is EPA's intent that remediation, including required compensatory mitigation, of the CB/NT site cumulatively contribute toward the recovery of ESA listed species. Drawing from the Simenstad report, EPA has identified the following "performance criteria" that must, at minimum, be addressed in any acceptable compensatory mitigation plan:

1) All compensatory mitigation must be consistent with the criteria and findings of the Simenstad report.
2) Preference will be given to compensatory mitigation plans that are consistent with habitat function prioritization criteria[1] (to be determined).
3) All compensatory mitigation plans will include an assessment of how they contribute toward recovery.
4) Mitigation plans must include consideration for connectivity (i.e., habitat that is linked or capable of being linked to other habitat and is intended to avoid mitigative actions that are geographically isolated and underutilized by the target species and/or do not reach full function).
5) Compensatory mitigation sites will be located within or will provide connections to or between one or more of the critical areas of "salmon landscape" (e.g., osmoregulatory transition) described by the Simenstad report within the Commencement Bay and lower Puyallup River watershed.
6) The aspect of *risk* of mitigation success/failure must be specifically factored into habitat plans and provided for up-front rather than solely as a post-construction contingency (i.e., in most cases this will mean additional habitat acreage).
7) All compensatory mitigation plans will include measurable performance objectives, management, monitoring and reporting requirements, responsibilities, and schedule.
8) Native species only will be utilized in any plantings to the maximum extent practicable.
9) Mitigation plans should include facility design and site plans for any development/redevelopment that occurs as a result of a fill. The facility and site

[1]The Simenstad report identifies "several emerging "visions" on broad-scale restoration of the delta-Bay" (p. 3) as well as efforts for upriver restoration (p. 9). The report also identifies a number of parcels or groups of parcels as potential sites. No prioritization of those opportunities has occurred to date. EPA will prioritize preferred habitat functions after consultation with the Services, resource agencies, and the Tribes.

plans must ensure that the facility and site characteristics and functions do not create adverse impacts to water, sediment and habitat quality during construction and operation. For example, the site plan for the expanded Simpson facility should include on- and off-site stormwater treatment; beneficial use of relatively clean stormwater (e.g. rooftop runoff, treated stormwater etc.); lighting and noise impacts minimization, including buffering; and other site-specific best management practices.

Compensatory mitigation plans will be developed pursuant to these performance criteria and in consultation with EPA and resource agencies, and be submitted to and approved by EPA during the remedial design phase. EPA may consider mitigation proposals that do not meet all of the performance criteria if the PRPs demonstrate that the proposal is otherwise consistent with the Simenstad report or otherwise significantly contributes to conservation and recovery of ESA listed species.

None of the compensatory mitigation plans submitted to date have been approved by EPA at this time. In addition, 4.6 acres of intertidal habitat within Thea Foss Waterway and 2.7 acres of intertidal habitat within Hylebos Waterway will be lost due to planned remediation in those waterways and have not been accounted for in any of the compensatory mitigation plans or documents provided to EPA. See Section V., *Habitat Considerations* subsections for Thea Foss and Hylebos waterways for more detail on habitat loss from the cleanup plans.

V. DESCRIPTION OF THE IN-WATERWAY REMEDIAL ACTIONS

A. Thea Foss and Wheeler-Osgood Waterways

In March 1994, the City of Tacoma entered into an Administrative Order on Consent (AOC) with EPA to conduct the design of the remedial action for the Thea Foss and the Wheeler-Osgood waterways. The City has analyzed previous data, conducted additional studies regarding the nature and extent of contamination in the waterways, and prepared a pre-design evaluation. The studies and evaluations to date include the following:

a) three rounds of sampling,
b) a feasibility study to evaluate cleanup actions for NAPL seeps located at the head of the Thea Foss Waterway,
c) an evaluation of potential disposal sites for dredged contaminated sediments,
d) an evaluation of the potential for sediment recontamination after cleanup, and
e) an underwater survey at the head of the waterway to locate the source of NAPL seeps beneath the SR 509 bridge.

These studies and evaluations are contained in the following reports which have been reviewed by EPA and placed in the Administrative Record:

a) Round 1 Data Evaluation Report, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington, May 30, 1995.

b) Screening of Remedial Options Report, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington, November 15, 1996.

c) Round 2 Data Evaluation Report, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington, January 17, 1997.

d) Round 3 Data Evaluation and Pre-Design Evaluation Report, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington, September 30, 1999.

e) SSMA 7 Technical Update, Memorandum from Hart Crowser to the City of Tacoma , dated June 14, 2000.

The areas within the waterways that require cleanup have been identified. The Thea Foss and Wheeler-Osgood waterways have been organized into Superfund Sediment Management Areas (SSMAs). There are seven SSMAs and they are depicted in Figure 2. The studies that have been completed indicate that the most severe contamination at surface and at depth occurs in segments 6 and 7 and tapers off gradually towards the Mouth of Thea Foss in segments 2 and 1. Primary contaminants found throughout the waterways that require cleanup both at surface and subsurface are BEP and PAHs. Other contaminants, such as metals are more localized. The head of the waterway (SSMA 7) contains deposits of NAPL beneath the sediments. This NAPL presents an ongoing source of conatmination to the waterway via seeps that transport the NAPL to the surface sediments.

Except for SSMA 1, substantial active remediation is needed to achieve cleanup objectives. The following paragraphs describe EPA's remediation plan for Thea Foss and Wheeler-Osgood waterways that is consistent with the remedial action EPA selected in the ROD. EPA's remediation plan is similar to the City of Tacoma's preferred alternative, Alternative 5B, described in the "Round 3 Data Evaluation and Pre-Design Evaluation Report" and in a subsequent technical memorandum. However, EPA's selected remedy for SSMA 7 includes a contingency for additional source removal and/or modification of the cap design if the established performance criteria cannot be met by the City's remedial design and implementation. EPA's remedy also differs from the City's in that it designates some additional areas for either natural recovery or enhanced natural recovery. EPA's remedy is described below.

SSMA 1 (Station 0+00 to 20+00)

No action is required in most of this segment except for SSMAs 1e1 and 1e2, where a cap will be placed to ensure that an area of sediments contaminated with hexachlorobenzene is remediated.

The approximate capping volume required to remediate this area is 15,000 cy of clean material. The remedial action will maintain the current navigable elevation of at least -29 feet MLLW.

SSMA 2 (Station 20+00 to 35+00)

The majority of sampling locations in this segment of the waterway indicate that chemical exceedances are marginal. EPA is requiring natural recovery at those areas where marginal exceedances occur because minor adverse biological effects were predicted for these areas in the City's Round 2 Report. These areas are SSMAs 2b1, 2b3, 2c1a, and 2c1b. In addition, a few discreet areas within SSMA 2 require either capping or dredging. SSMA 2a2 which is adjacent to an upland bank will be capped. Other areas, such as SSMA 2b4 and 2b5 will be dredged approximately four feet to remove all contaminated sediments. While this will eliminate the need for a cap, these areas will be backfilled with clean material to the approximate elevation of surrounding areas.

The estimated total volume for dredging and capping/backfilling this segment is approximately 16,000 cy and 15,000 cy, respectively. The remedial action will maintain the current navigable elevation of -29 feet MLLW.

SSMA 3 (Station 35+00 to 46+40)

The majority of areas within SSMA 3 have SQO exceedances that require removal and/or capping. SSMAs in the navigation channel between the 11th Street Bridge and the 15th Street right of way (ROW) (SSMAs 3b1, 3b2, 3b3, 3b4, 3b5a, and 3b5b) will be dredged to a specified elevation of -32 feet MLLW (elevation -30 feet MLLW with a 2-foot over dredge allowance) to remove all contaminants. Post-dredge samples will be taken to assess chemical concentrations of the dredged surface. If necessary, further dredging and/or some amount of capping may be required. Non-channel areas will undergo a combination of cleanup actions, including no action, natural recovery, capping, and dredging. SSMA 3a1 requires no action based on existing conditions. SSMAs 3a2 and 3a3 are suitable for natural recovery. SSMA 3c1 will undergo a combination of cleanup actions including natural recovery, enhanced natural recovery, dredging and capping. SSMA 3c2 and 3d are areas suitable for capping.

The estimated capping volume for this segment is in excess of 23,000 cy; the dredging volume is approximately 206,000 cy. The navigation channel along this section is authorized to an elevation of -22 feet MLLW. As the channel will be dredged to -32 feet MLLW, this remedial action meets navigation requirements.

SSMA 4 (Wheeler-Osgood Waterway)

Chemical exceedances in this segment indicate that active remediation needs to occur in two main areas: SSMAs 4a and 4c. These areas will be dredged to remove contaminated sediments. It is expected that all contaminants will be removed. The City's studies suggest that dredging SSMA 4a four feet will remove all contaminants. It is expected that SSMA 4c will be dredged to an elevation of -8 feet MLLW (which includes 1 foot of over dredge) to remove all contaminants. This area will then be capped/backfilled to match the current bathymetry for habitat benefits. Approximately 5,000 cy and 22,100 cy will be dredged from SSMAs 4a and 4c, respectively.

In addition, the City of Tacoma recommended no action areas where there are chemical exceedances of the SQOs. EPA requires that these areas be designated as natural recovery areas. If long-term monitoring indicates these areas will not achieve SQOs within 10 years after remedial action, they must be remediated.

The total volume of dredge material from SSMA 4 will be approximately 27,000 cy. The total amount of cap/backfill material needed for SSMA 4 will be nearly 20,000 cy. The Wheeler-Osgood Waterway is not part of the navigation channel. Current elevations will be maintained.

SSMA 5 (Station 46+40 to 52+40)

The navigation channel along this section is divided into two authorized navigation elevations. Between the 11th Street Bridge and the 15th Street ROW, the navigation channel is authorized to an elevation of -22 feet MLLW. From the 15th Street ROW to Station 52+40, the navigation channel is authorized to an elevation of -19 feet MLLW. These areas (SSMAs 5b1, 5b2a, 5b2b, 5b3a, 5b3b and 5b4) will be dredged to a specified elevation of -32 feet MLLW (which includes 2 feet of over dredge) to remove contaminants. It is expected that dredging to this depth will remove all contaminants.

Areas outside of the navigation channel will have a combination of remedial actions, including no action, natural recovery, capping, and dredging. Although SSMAs 5a1 and 5a3 will require no action based on existing conditions, a portion of these SSMAs will be dredged as part of the channel slope. The portions of the bank that the City recommended as no action areas have chemical exceedances of the SQO for copper and zinc; therefore, EPA requires that these areas be remediated either through capping or dredging because banks are not suitable for natural recovery. SSMAs 5c and 5a2, which are located along the channel slope, will be partially dredged. Caps will completely cover these SSMAs to confine remaining contaminants.

The remedial actions in this segment will result in total dredge and cap volumes of approximately 198,000 cy and 16,000 cy, respectively.

SSMA 6 (Station 52+40 to 62+30)

The navigation channel along this section is authorized to an elevation of -19 feet MLLW, however, it will be dredged to an elevation of -24 feet MLLW. Data collected by the City suggests that in places contamination may be considerably deeper. Consequently, a cap will be placed over dredged surfaces resulting in an elevation of -21 feet MLLW which will be 2 feet below the authorized channel depth.

Non-channel areas will receive a combination of no action, natural recovery, dredging and capping. Based on existing conditions, SSMAs 6a2a and 6c will require no action. SSMAs 6a2b and 6b3, located on the east side of the waterway under the Fishing Fleet, will be dredged to an elevation of -17 feet MLLW to remove all contaminated sediments and accommodate marina users. SMAs 6b4 and 6b5 will be dredged to an elevation of -13 feet and capped back to elevation -10 feet because there are contaminated sediments at depth.

Dredging these areas will result in more than 92,000 cy of sediment needing disposal. Capping will require approximately 58,000 cy of clean material.

SSMA 7 (Stations 62+30 to 72+40 and 77+50 and 80+00)

Contamination in this segment of the waterway is deep and in excess of the authorized navigation depth of -19 feet MLLW. Sediments in SSMA 7b2 within the navigation channel between Stations 62+30 and 68+00 will be dredged to elevation -26 feet MLLW (elevation -24 feet including 2-foot over dredge). This will result in a channel approximately 5 feet below the required channel depth for navigation (-19 feet MLLW) in this area. In SSMA 7b3a, the dredge cut within the navigation channel will taper from -26 feet MLLW at Station 72+00 to -13 feet MLLW near Station 72+40. A cap will be required throughout this area because the majority of sediments at this depth and deeper contain chemical concentrations above SQOs. Following placement of the cap, the mudline elevation will be 2 feet below the authorized channel depth up to Station 72+00 and taper to a final elevation of -10 feet MLLW near Station 72+40.

Non-channel areas including SSMAs 7a and 7b1 (located on the east side of the waterway) will be dredged to an elevation of -13 feet MLLW to provide room for potential marinas. SSMAs 7c, 7d1 and 7d2 will be dredged to an elevation of -13 feet and capped back to an elevation of -10 feet as contaminated sediments exist at depth at these locations.

EPA is selecting the approach recommended by the City of Tacoma for remediation and control of the NAPL at the head of the waterway (approximately from Station 72+00 to 80+00) provided performance criteria specific to source control are met prior to implementation of the remedy. The remedy for the head of the waterway includes the following:

a) Placement of a composite multilayered cap which may consist of sand, sorbent material and geotextile membrane over areas that have active NAPL seeps, to cap and contain those seeps. (The cap must meet the performance requirements described in Section IV. A. and E. above.)

b) Dredging of sediments (some of which may be heavily contaminated with NAPL) as needed for construction of the cap.

c) The appropriate treatment and/or off-site disposal of the contaminated sediments as determined by testing.

d) Placement of at least 3-foot thick sand caps in areas which do not have composite capping material.

f) Placement of a sheet pile wall across the waterway north of the State Route 509 bridge to provide stabilization between the cap in SSMA7 and the remainder of the navigable waterway.

Dredging the channel and slopes will result in approximately 81,000 cy of dredged sediments needing disposal. Caps will be placed throughout SSMA 7 resulting in a total cap volume of approximately 108,000 cy.

Since the post-remediation depth proposed for the head of the waterway (between the north edge of the SR-509 bridge and the head of the waterway) will be more shallow than the federally authorized navigation depth, the City of Tacoma submitted a request to the Army Corps of Engineers (Corps) on August 19, 1999, to partially deauthorize this portion of the navigation channel. Deauthorization is necessary for the cleanup at the head of the Thea Foss to substantially comply with the Rivers and Harbors Act, which is an ARAR. The Corps regional office has completed a public comment period on the deauthorization, and has forwarded its recommendation to deauthorize this portion of the channel to Corps Headquarters. After approval by the Corps, the deauthorization request will be forwarded to the Secretary of the Army and then to Congress for approval.

Thea Foss and Wheeler-Osgood Waterway Cleanup Areas and Volumes

In summary, the remediation plan for Thea Foss Waterway will result in approximate dredging and disposal volumes of 620,000 cy and approximate capping volumes of 255,000 cy. An additional estimated 25,000 cubic yards of sediment and NAPL will be dredged from the heavily contaminated area at the head of the waterway for placement of the cap. These sediments will be tested to determine the appropriate disposal option. If necessary, the sediments from the head of the waterway will be dewatered, treated and disposed off-site.

The remedial action will result in the complete dredging of approximately 24 acres; capping of approximately 32 acres (including some areas that will be dredged and then capped); natural recovery of 21 acres, enhanced natural recovery of approximately 4 acres; and no action at 37 acres.

Complete removal of contaminated sediments will occur in a substantial portion of the navigation channel specifically between the 11th Street Bridge and 15th Street. The waterway will be left deeper than -24 feet MLLW, which is 2 feet below the authorized navigational depth of -22 feet MLLW. This will allow for future maintenance dredging of the waterway. Between 15th Street and approximately station 72+00, the waterway also will be dredged to remove contaminated sediments. However, because the channel is narrow and the contamination deep, it is more difficult to remove all contaminated sediments from this part of the waterway. Therefore, after dredging, a cap of clean sediments will be placed to contain remaining contaminated sediments. In this area, the top of the cap will be left at or deeper than -21 feet MLLW which is 2 feet below the present authorized navigational depth of -19 feet MLLW.

From approximately station 72+00 to the north edge of the SR-509 bridge, there will be a transition to a capping area. As a result, there will be some dredging along this slope and placement of a confining cap. Subject to meeting the performance criteria as described above for SSMA 7, the remaining area between the north edge of the SR-509 bridge and the head of the waterway will be capped to confine the contaminated sediments in place, leaving the channel depth in this area at an elevation of approximately -10 feet MLLW. Harbor areas that require active remediation also will be: (1) dredged to remove all contaminants, (2) dredged to a specified elevation and capped, or (3) capped. Areas near the Mouth of the Thea Foss with marginal exceedances of the SQOs will undergo natural recovery. Other areas will be capped with minimal volumes of clean material to immediately isolate marginally contaminated sediments and enhance the natural recovery process.

Habitat Considerations

Dredging and capping would sequentially eliminate non-mobile benthos over approximately 56 acres of bottom area during an estimated 1-2 years of construction. These activities, along with natural recovery, would leave a patchwork of clean to much less contaminated bottom that would be predominantly native silty sands rather than the existing, organically enriched sandy silts. The bottom sediments exposed by dredging or created by the cap fill are expected to meet SQOs and to rapidly re-colonize with infauna and epifauna. Dredging and capping would cause temporary and localized impacts to water quality in the vicinity of the active equipment during construction. In-water work would be conducted during periods when few juvenile anadromous fish are present in the nearshore waters to reduce or eliminate the risk of direct impacts to this important resource.

Remedial activities would result in a small decrease in overall area (0.21 acres) below the mean higher high water level (MHHW) due to capping of the bank areas. Total area between MHHW and elevation -10 feet MLLW would decrease by up to 4.6 acres due to dredging to remove contamination. Deeper water habitat area (deeper than -10 feet MLLW) would be increased by that same 4.6 acres, but this is judged to be an unavoidable adverse impact, which requires compensatory mitigation. Habitat quality overall should be improved throughout the two waterways because of the removal or confinement of contaminated sediment. Additionally, provision of soft or organic-rich substrates beneficial to salmonids (e.g., "fish mix" or a silt-sand mix) will be investigated for use as final capping material.

EPA will require compensatory mitigation consistent with the bay-wide mitigation and performance standards discussed in Section IV.F. to offset any loss of habitat, as well as careful timing and monitoring of dredging and capping activities to assure minimal short-term impacts and minimal disruption of migratory salmonids. The resulting substrate should greatly benefit fish and wildlife resources by removing and isolating highly contaminated sediments from biological uptake. EPA will also ensure conservation measures are taken to protect ESA listed species.

B. Hylebos Waterway

EPA and the Hylebos Cleanup Committee (HCC), which consists of ASARCO, Inc., Elf Atochem North America, Inc. (now ATOFINA Chemicals, Inc.), General Metals of Tacoma, Inc., Kaiser Aluminum and Chemical Corporation, Occidental Chemical Corporation, and the Port of Tacoma, entered into an AOC for a pre-remedial design study of the Hylebos Waterway in November

1993. Under the AOC, the HCC has collected more than 500 physical, chemical, and biological samples in two sampling rounds to characterize the nature and extent of contamination, and has developed a cleanup plan to address areas that exceed the SQOs set forth in the 1989 ROD and the 1997 ESD. The HCC also has evaluated the potential for sediment recontamination after cleanup, and has inventoried and evaluated potential disposal sites for dredged contaminated sediments.

During the course of pre-design studies, it was determined that two areas of the Hylebos Waterway should be addressed separately from the overall waterway cleanup described in this ESD, because the materials present are different than the rest of the waterway sediments. In one area, a group of wood products companies (known as the "Wood Debris Group") are working with Ecology to investigate the extent of wood debris in the turning basin at the head of Hylebos Waterway. They are also evaluating options for remediation of wood debris. Ecology's public comment period for the Cleanup Action Plan for the wood debris cleanup closed July 28, 2000.

In the second area, Occidental Chemical Corporation is working with EPA under a separate AOC for two Removal Actions to investigate the extent of, and cleanup options for, a subtidal area known as "Area 5106" and a contaminated embankment in front of the former Occidental facility and an adjacent property at the Mouth of the Hylebos Waterway. In Area 5106, the nature of the sediment contamination is different than other Hylebos sediments, and, if excavated, would require treatment prior to disposal. This area is referred to as the "Area 5106 and Embankment Study Area" in Figure 3a. EPA has issued a separate proposed Engineering Evaluation and Cost Analysis (EE/CA) document for Area 5106 and is receiving public comment during August 2000. After responding to public comments, EPA will prepare an Action Memorandum (analogous to this ESD) to implement the removal action. For the Area 5106 sediments, the EE/CA addresses only those sediments that require treatment prior to disposal. A separate comment period for the embankment area is expected in the fall 2000. EPA's selected action for the embankment area will also be documented in an Action Memorandum. Sediments around and under the 5106 removal area that exceed SQOs but that are outside of the embankment will be addressed under this ESD in the overall Hylebos cleanup. Depending on the selected remedy in EPA's Action Memorandum, an estimated 20,000 cy of treated dredge material from Area 5106 could be disposed of in one of the selected disposal sites identified in this ESD. Because the Area 5106 may be disposed of in one of the selected disposal sites after treatment, the estimated 20,000 cy volume has been included in the estimated total disposal volume for this ESD.

Hylebos Waterway Subtidal Cleanup

The HCC's studies showed that extensive areas at the mouth and head of the Hylebos Waterway, and more limited areas in the middle of the waterway, are contaminated with chlorinated organic chemicals (including PCBs, pesticides, hexachlorobenzene, and hexachlorobutadiene), PAHs, and metals, and will require remediation.

Under the requirements of the AOC, the HCC developed a Pre-Remedial Design Evaluation Report (November 8, 1999), which contains a proposed cleanup plan for contaminated sediments in the Hylebos Waterway, and proposed disposal sites for dredged sediments. The proposed cleanup plan is shown in Figures 3a-c, and is described in more detail in the report.

As shown in Figure 3a, most of the waterway north of the 11th Street Bridge is to be dredged under the cleanup plan. The area in front of Ole and Charlie's Marina (Sediment Management Area , "SMA" 511), within and in front of the Chinook Marina (SMA 501), and a small area near the 11th Street Bridge (SMA 502) contain only low-level contamination and will be monitored as natural recovery areas.

In the middle of the waterway (Fig. 3b), three areas will be dredged: SMA 421 in front of Taylor Way Properties, SMA 321, a small area near Buffelen Woodworking, and SMA 322 in front of Murray Pacific Corp. (now Port of Tacoma), Modutech, and Hylebos Marina. There also are four small natural recovery areas in the middle of the waterway.

At the head of the waterway (Fig. 3c), most of the waterway from approximately station 110+00 to station 147+00 will be dredged, with the exception of a small natural recovery area at the General Metals graving dock and in front of the General Metals facility. In the upper turning basin, a small area of chemical contamination in front of the Puyallup Tribe's Outer Hylebos property will be addressed as part of this cleanup. The remainder of the upper turning basin will be addressed under a separate cleanup by the Hylebos Wood Debris Group. There are also some small natural recovery areas in the upper turning basin.

As discussed in Section IV, the cleanup must protect against exposure of buried contaminated sediments in the future. Based on existing information, EPA has designated areas for cleanup where there are high or moderate subsurface contamination levels that have a greater potential for exposure, due to their proximity to the navigation channel or remediation dredge areas. There are a few sampling stations with lower-level subsurface contamination, or with insufficient subsurface data to refine the dredging volume. In these instances these areas will require further evaluation during design to determine which areas present a long-term risk of exposure of significant levels of subsurface contamination (e.g., an estimated 20,000 cy area noted as SMA S44 in Fig. 3b must be refined). For the remaining areas not identified for EPA action in this ESD, where and when future dredging or excavation will occur is unknown, but any such activity will be overseen by regulatory agencies as required under the Clean Water Act and the Shoreline Management Act, thus immediate removal of such subsurface sediments is not required. EPA does, however, encourage parties with development needs that involve dredging to consider coordinating their activities with EPA's cleanup schedule. Such a coordinated effort could serve to reduce cost and streamline administrative processes for property owners more than if they wait to initiate work after the Superfund cleanup. This issue is discussed further in the following section, *Hylebos Waterway Cleanup Areas and Volumes.*

Areas requiring dredging will be dredged deep enough to expose clean sediments. In most cases this coincides with the depth of native sediments. Proposed thickness of dredging ranges from 2 to 20 feet, with an average of 6 feet.

The cleanup areas shown in Figures 3a-c represent a preliminary cleanup plan, with specific dredged material management areas and volumes to be finalized and approved by EPA in remedial design.

Hylebos Waterway Intertidal Cleanup

Figures 3a-c also show intertidal areas that require cleanup. The plan presented in the Pre-remedial Design Evaluation Report is for 11.6 areas under dock/structures and isolated intertidal areas to be capped. However, whether intertidal areas will be dredged or capped will be reevaluated in the design phase on a property by property basis, taking into account factors such as:

- protectiveness of the proposed cap,
- compatibility with current land use,
- property owner's willingness to implement use restrictions on the capped area and/or ensure such restrictions will run with the land,
- engineering constraints, and
- avoidance of habitat impacts and any necessary mitigation required under CWA Section 404.

Some intertidal cleanup actions have been addressed by individual property owners working with Ecology. Those intertidal cleanups where EPA has approved the final cleanup will not require remediation as part of the overall waterway cleanup. EPA will, however, determine whether long-term monitoring is needed at these properties as part of the waterway design process. To date, EPA has approved the intertidal cleanups at SMA 232 at General Metals of Tacoma and SMA 241 at the former USG Interiors facility (see Figure 3-c).

Hylebos Waterway Cleanup Areas and Volumes

The total area of the Hylebos Waterway is 285 acres. Under this cleanup plan, 85.5 acres of open access areas (825,000 cy) will be dredged, 11.6 acres (95,000 cy) of intertidal and dock/structure area will be either dredged or capped depending on the final remedial design, and 20.7 acres are natural recovery areas. Additional acreage will be cleaned up under the Occidental Chemical and Wood Debris Group response actions. The total dredging volume represented by the sediment cleanup shown on Figures 3a-c is 845,000 cy, which includes the 20,000 cy estimated for SMA S44. For the purposes of estimating needed disposal site capacity, EPA has assumed that both SMA S44 area, and the intertidal or dock/structures areas will be dredged for a total of 940,000 cy. The estimated cost of this remedy, assuming disposal of dredged sediments at the Blair Slip 1 disposal site and an Upland Regional Landfill is $46,137,000.

An additional volume of contaminated sediments in the Hylebos Waterway may require confined disposal if dredged for navigation or future development purposes. Hylebos Waterway is a federally authorized navigation channel with an authorized depth of -30 feet MLLW. EPA is working with the Corps to determine whether the Superfund cleanup can be coordinated with additional dredging by the Corps at the request of waterway users. This would increase the volume of sediments dredged and requiring confined disposal, but would address waterway users' concerns about shoaling in the navigation channel. It would also minimize future ecological impacts due to dredging by helping to ensure that no further dredging of the Hylebos Waterway would be needed for many years.

Some property owners also may wish to include additional dredge areas if their future use plans may require dredging and, as a result, risk future exposure of buried contaminated sediments. Because of the difficulties associated with dredging and disposal of contaminated sediments, EPA encourages property owners and waterway users to consider any current or future additional dredging needs and to discuss with EPA whether this dredging can be coordinated with the cleanup. While dredging solely for navigation or other development purposes is outside the scope of this Superfund action, EPA will work with private parties and the Corps to integrate additional dredging activity into the remedial design schedule if there is interest by the parties. For the purposes of determining needed disposal site capacity, EPA has estimated that an additional 120,000 cy of capacity may be needed if a Corps dredging project and dredging by other waterway users is included in the cleanup.

A number of factors could alter EPA's estimate of 120,000 cy of additional sediment resulting from dredging. EPA's estimate of 120,000 cy is based on a conditions survey conducted by the Corps that estimated 120,000 cy of dredging would be needed to address shoaling areas that are currently impacting navigation in the waterway. The Corps' 120,000 cy estimate includes some overlap with the CERCLA remediation areas, however, it does not include any additional dredging to address contaminated surfaces that may remain after the shoaling areas are dredged, which could increase the volume. The Corp's estimate also does not address any potential needs for development purposes. The draft ESD cited an additional volume of 300,000 cy based on the possibility of a much larger Corps dredging project beyond the shoaling areas identified in the Corp's conditions survey.

To pursue any Corps dredging project would require resolution of a number of issues that cannot be fully addressed at this time, including level of interest by private parties. For example, any navigation dredging would need to be initiated by a local sponsor and would require private parties to coordinate with the Corps to determine the precise dredging volume and subsequent cost sharing arrangements required for dredging and disposal. EPA encourages parties with an interest in additional dredging to work together to resolve these issues.

Habitat Considerations

Remedial activities in the Hylebos Waterway would result in the dredging and/or capping of approximately 96 acres of bottom area during an expected 2-3 year construction period, sequentially eliminating non-mobile benthos over that area. These actions include the capping of 11.6 acres of intertidal and shallow subtidal habitat and the dredging of 85.5 acres of subtidal habitat. In the intertidal area, approximately 2.7 acres of intertidal habitat would be converted to subtidal habitat. The resulting substrate would consist of clean imported sand or clean native sediment. These activities, along with natural recovery, would leave much less contaminated bottom sediment which is expected to result in improved habitat quality throughout the waterway. The bottom sediment exposed by dredging would re-colonize with infauna and epifauna, as would any cap sediment. Dredging and capping activities would cause temporary and localized impacts to water quality in the vicinity of the active equipment during the construction period. In-water work would be conducted during periods when few juvenile anadromous fish are present in the nearshore waters to reduce or eliminate the risk of direct impacts to this important resource. The net effect of these changes to the aquatic ecosystem would be the loss of 2.7 acres of intertidal habitat, which will require compensatory mitigation. The remedial actions may also result in the loss of a very small area of salt marsh (approximately 25 square feet). It may be possible to avoid impacting this area, and this will be closely scrutinized during development of the final project design. Habitat quality for the remainder of the site overall would increase because of the removal of contaminated sediments. Additionally, provision of soft or organic-rich substrates beneficial to salmonids (e.g., "fish mix" or a silt-sand mix) will be investigated for use as final capping material.

EPA will require compensatory mitigation consistent with the bay-wide mitigation and performance standards discussed in Section IV.F. to offset the 2.7 acres and any additional loss of habitat, as well as careful timing and monitoring of dredging and capping activities to assure minimal short-term impacts and minimal disruption of migratory salmonids. The resulting substrate should greatly benefit fish and wildlife resources by removing and isolating highly contaminated sediments from biological uptake. EPA will also ensure conservation measures are taken to protect ESA-listed species.

C. Middle Waterway

EPA and the Middle Waterway Action Committee (MWAC), which is comprised of Foss Maritime Co., Marine Industries Northwest, Inc., and Pioneer Industries, Inc., entered into an AOC for preparation of pre-remedial and remedial design studies for Middle Waterway in April 1997. Under the AOC, MWAC has completed two rounds of sampling to characterize the nature and extent of contamination. MWAC submitted a draft data evaluation report, draft evaluation of remedial options, and draft remediation plan to EPA in June 2000, which are currently under review by EPA. MWAC currently estimates that 75,000 cubic yards of contaminated sediments may require removal.

Contaminated sediments dredged from Middle Waterway will be disposed of in one of the sites selected in this ESD. EPA will issue a future ESD for public comment, which defines the areas of Middle Waterway to be remediated.

VI. DISPOSAL SITES

A. Background

Since 1996, EPA has held several meetings and discussions with potentially responsible parties, representatives of federal, state, and local government, Native American tribes, environmental groups, and members of the public. EPA met with these parties in an effort to: 1) identify potential disposal sites that meet the criteria set forth in the 1989 ROD, 2) discuss the pros and cons of each site and 3) narrow the list of potential sites to those sites most acceptable to EPA and other parties. Ten sites were identified by this process. EPA's further internal analysis narrowed the list to a few candidate sites.

In June 1999, EPA issued a fact sheet that presented EPA's evaluation of disposal sites for confinement of contaminated sediments dredged from Thea Foss, Wheeler-Osgood, Hylebos, and Middle waterways. The fact sheet described the factors used to evaluate the disposal sites and provided a refined list of promising sites. The list included nearshore fills at Blair Slip 1 and St. Paul Waterway, and confined aquatic disposal sites at Mouth of Hylebos and the Hylebos Upper Turning Basin. Along with these four in-water sites, EPA retained the option to send some volume of contaminated sediments to a regional upland landfill. EPA stated that it would focus further technical evaluations on these promising disposal sites. EPA also solicited public comment on the evaluations and information provided in the fact sheet and the proposed disposal site list. The comments received on EPA's refined list of disposal sites were considered in developing this ESD, and are discussed in Section X.

Subsequent technical evaluations indicated that construction of the Hylebos Upper Turning Basin disposal site would involve serious technical challenges, and may adversely impact migrating salmon. The proposal for the Hylebos Upper Turning Basin disposal site was to build an underwater confined aquatic disposal (CAD) facility at the end of a long, narrow channel, in an area of low circulation and flushing. Due to ongoing deposition of fine sediments with high organic content, near-bottom dissolved oxygen levels drop below levels necessary to support sensitive aquatic species for much of the summer and fall. Dredging and disposal may further reduce dissolved oxygen levels. The turning basin is located at the mouth of Hylebos Creek, a salmon bearing stream. Fish must pass through the disposal site to reach Hylebos Creek. In EPA's judgement, the Hylebos Upper Turning Basin disposal site, while not infeasible, had some serious technical challenges to overcome, and it is uncertain whether migrating salmon could be protected during construction. For these reasons, EPA has not selected this disposal site.

In November 1999, EPA issued a draft ESD proposing disposal of dredged contaminated sediments at three in-water disposal sites: Blair Slip 1, St. Paul Nearshore Fill, and a CAD at the Mouth of the Hylebos Waterway. EPA believes the Mouth of Hylebos site satisfies EPA's threshold criteria of overall protectiveness and compliance with ARARs, and is cost effective and technically implementable. However, based on public comments and further evaluation of the Mouth of Hylebos disposal site, EPA has determined that it is not an administratively implementable alternative at this time. Several issues have been raised about use of the Mouth of Hylebos Waterway disposal site that have not been resolved, including:

1) the landowner, DNR's, stated preference that CADs only be used for temporary disposal while EPA sees them as a long-term solution;
2) lease rates for use of state-owned, aquatic land;
3) need to relocate an existing lease holder at the mouth of the Hylebos;

4) a waiver or Plan amendment of the City of Tacoma's Shoreline Master Plan would be needed, because the majority of the mouth of Hylebos site is in the district S-13, which is designated a "conservancy environment"; and
5) numerous adverse comments received from homeowners, members of the public, and environmental groups.

All of these issues could potentially be resolved, however resolution is expected to be time-consuming. During that time, cleanup would be stalled.

Because EPA has determined that the Mouth of Hylebos CAD is not an administratively implementable alternative at this time, EPA is selecting upland disposal in a regional landfill as an element of the CERCLA remedy in conjunction with the Blair Slip 1 and St. Paul Waterway disposal sites. EPA has determined that the upland regional landfill alternative is feasible and cost-effective, and best meets the CERCLA evaluation criteria.

After the public comment period on the draft ESD closed (February 2000) and the many issues concerning the CAD site at the Mouth of the Hylebos were clarified, a group of four Hylebos Waterway potentially responsible parties hired a neutral third-party facilitation firm, Merritt and Pardini, and requested EPA's support and participation in a public outreach process to develop a solution for disposal of contaminated sediments dredged from Hylebos Waterway. EPA participated in the outreach process, which consisted of a series of three workshop sessions held over a three-month period from March through June 2000. A summary of the workgroup sessions and the workgroup's "Consensus Statement and Conclusions" were provided to EPA on June 21, 2000. The consensus statement is to:

1) Maximize the capacity of Blair Slip 1;
2) Maximize the use of upland industrial fill site(s) (i.e., Kaiser, others);
3) Upland disposal, capping, and Puget Sound Dredged Disposal Analysis [PSDDA; now Dredged Material Management Program (DMMP)] disposal as appropriate for residual volumes based on successful implementation of items 1 and 2;
4) Make sediment available for a treatment bench test if requested by a vendor; and
5) Based on assumed volume (of 940,000 cy) and contingent on the success of items 1 through 4, the Mouth of Hylebos CAD site is not part of this consensus statement.

In response to these recommendations, EPA agrees with the workgroup's recommendation (item 1) that the capacity of Blair Slip 1 be maximized to the extent practicable. EPA will also extend this recommendation to the St. Paul Waterway disposal site. The outreach forum's recommendation on upland industrial fill (item 2) was presented in sufficient concept-level detail to allow for further development during remedial design. The information presented in the recommendations was not, however, sufficient to allow EPA to select alternative on-site upland disposal sites rather than disposal of dredged materials in an upland regional landfill. EPA will allow PRPs to develop such alternatives during remedial design. If they can be demonstrated to EPA's satisfaction to be compatible with existing land use, protective of human health and the environment, compliant with applicable, or relevant and appropriate requirements and cost effective, then EPA will consider these on-site alternatives as a means to reduce or eliminate the need for disposal at an upland regional landfill.

EPA's ESD includes upland disposal, capping and DMMP disposal as appropriate (item 3). EPA is also willing to make contaminated sediments available to a vendor for bench testing of treatment technologies (item 4), if requested and if compatible with the cleanup schedule, but will not require any such testing of the potentially responsible parties (PRPs).

In summary, EPA has selected Blair Slip 1 and the St. Paul Nearshore Fill and disposal at an upland regional landfill as disposal sites to contain contaminated sediments dredged from Hylebos, Thea Foss, Wheeler-Osgood, and Middle Waterways. The location of these disposal sites is shown in Figure 4. EPA will consider an upland on-site fill as an alternative to disposal at an upland regional landfill if it meets the criteria discussed above. More detailed information about the selected disposal sites is provided below.

B. St. Paul Nearshore Fill

The St. Paul Nearshore Fill (see Fig. 4) will consist of a containment berm and dike of clean dredge material and/or select fill material across the mouth of the waterway. New intertidal habitat will be constructed on the face of the berm.

The fill will create an upland area on top of which Simpson Tacoma Land Company (hereafter Simpson) plans to expand its manufacturing facilities. In order to accommodate the volume of material that needs to be dredged from the Thea Foss, Wheeler-Osgood, and Middle waterways, the St. Paul Waterway must be deepened. A preliminary facility layout that will be refined in the final design process indicates that the St. Paul Fill will have a capacity of approximately 600,000 to 750,000 cubic yards. EPA requires that the St. Paul Nearshore Fill be utilized to its maximum feasible capacity. Once all the contaminated material that needs to be disposed is placed into the St. Paul Fill, the area will be covered by a 6 to 7 foot thick cap.

Construction of the St. Paul Fill will require relocation of the log haul-out facility currently located at the head of the St. Paul Waterway. Simpson is proposing to relocate the facility to the inner end of the subtidal portion of Middle Waterway, at the mouth. Simpson will need to receive approval from Ecology to ensure that their plans are consistent with Ecology policy concerning new log rafting and haul out areas. The relocated log haul out facility must be designed to avoid and minimize habitat impacts and to meet the Best Management Practices (BMPs) in the City of Tacoma's Shoreline Program and comply with practices recently agreed upon for log haul out in Hylebos Waterway (e.g. no log grounding and bark control). Design details of the facility will also need to be approved by EPA.

The creation of the nearshore fill will result in the loss of approximately 13.6 acres of littoral and subtidal aquatic habitat, including 7.6 acres of mudflats. This particular habitat loss is of great concern to EPA, the Trustees, the Puyallup Tribe, and other interested parties. Although the site has been degraded by historic industrial and commercial navigation use, it still provides important fish and wildlife support functions (refugia, feeding, migration) and compensatory mitigation is required to offset loss of habitat and other impacts.

After evaluation and input from the interested parties, Simpson developed a compensatory mitigation plan to offset losses due to the proposed nearshore fill. The mitigation plan was designed to emphasize recovery for migratory salmonid populations by providing a nearshore habitat connection between the Puyallup River and other existing nearshore habitats. The plan includes approximately 25 acres of estuarine habitat comprised of 15 acres of enhanced and 10 acres of created intertidal habitat, creation of a tidal channel and wetland marsh with a fresh water source, and preservation of land for a potential connector channel between the Puyallup River, the marshland, and Middle Waterway.

At this time, EPA is uncertain of the ability of the Upper Middle Waterway mitigation area to fully function as claimed. EPA believes there are insufficient baseline fish use and salinity data in both St. Paul and Middle Waterways to provide reasonable assurance that juvenile salmonid use will equal or exceed current use levels within the St. Paul Waterway impact area. This uncertainty is partially related to the fact that the St. Paul Waterway is closer to the Puyallup River and its associated fresh water turbidity plume compared to the more distant upper Middle Waterway. Consequently, the provision of a perennial source of river water to the compensatory mitigation lands in the upper Middle Waterway is critical to its functional success toward conservation and recovery of salmonids.

The Habitat Plan (April 2000) notes an option for supplying fresh water from the Puyallup River via rehabilitation and use of a City of Tacoma soon-to-be-abandoned water line along 11th Avenue that will become available in the year 2000 after a new water line is constructed. This pipeline option could potentially allow transfer of the necessary volume of fresh water to the Middle Waterway to achieve immediate benefits to salmonids, including development of brackish marsh habitat. In the future the pipeline could provide fresh water to potential restoration of intertidal brackish marsh and tidal channel habitats in the Delta Reserve/former industrial properties south of 11th Avenue.

EPA is requiring that this pipeline option, and other fresh water source(s) as necessary to meet the volume specifications, be implemented to assure full function of the mitigation project and, in part, to compensate for resource losses from the remedial activities in the Thea Foss Waterway.

Design of the pipe must meet the following requirements:

a) Maximize flow volume, but at a minimum must provide enough volume to create a freshwater lens six inches deep under stratified conditions and extends at least two-thirds the length of the waterway. Pumped artesian well water can be used as necessary to achieve the minimum flow volume. Appropriately treated stormwater or stormwater that meets the appropriate discharge standards may also be used to supplement the flow, but the preferred supplemental source is artesian well water.

b) The capability to eventually divert flows from upper Middle Waterway to the former industrial properties south of 11th Avenue, if those properties are acquired for restoration purposes.

Additionally, EPA has determined that the *risk* of mitigation success/failure must be specifically factored into habitat plans and provided for up-front rather than solely as a post-construction contingency. Accordingly, EPA will require additional acres of aquatic habitat be constructed in addition to what is proposed in the *Habitat Plan and Design Report* (2000) to offset the risk of mitigation failure. EPA will ensure that the requirements specified in this section, and the performance criteria specified in Section IV.F., are included in a final compensatory mitigation plan during remedial design that must be approved by EPA.

C. Blair Slip 1

The Blair Slip 1 disposal site is located at the mouth of the Blair Waterway. The Port of Tacoma has applied for a permit to fill this slip to the ground surface with clean fill (although they have indicated a willingness to use contaminated sediments as fill if required by EPA). The fill project would consist of constructing a berm across the front of the existing slip and filling behind the berm with contaminated sediments to an elevation of +9 feet MLLW, then adding a 7-foot sand cap, converting 13 acres of aquatic land to upland. This fill would be part of a larger Port project to build a new terminal at this location. The Port's permit application is currently under review by the Corps. With this ESD, EPA requires that this slip be filled with contaminated sediments. The current capacity of this site is 640,000 cy.

Information developed by the Port of Tacoma indicates that the slip capacity could be expanded to 750,000 cy if additional clean material is dredged from the bottom of the slip and sent for disposal at a DMMP open-water site. This ESD requires Blair Slip 1 to be designed to utilize its maximum capacity for contaminated sediments to the extent technically practicable.

The creation of a nearshore fill at this site will result in the loss of 13.1 acres of aquatic habitat (including 3.1 acres of intertidal and shallow subtidal habitat). Large piers currently cover the majority of the intertidal and shallow subtidal habitat. An additional 1.1 acres of subtidal habitat would be converted to shallow subtidal and intertidal habitat. Approximately 0.6 acres of existing subtidal habitat would be modified into sloping subtidal habitat.

Mitigation is required under Section 404 of the Clean Water Act to compensate for the impact of the fill on marine habitat. The draft compensatory mitigation plan for use of Blair Slip 1 (December 1998) that was submitted to the Seattle District, Corps of Engineers, as part of the permit application process is insufficient to offset habitat losses and it is unclear as to how it would contribute to conservation and recovery of ESA-listed species. EPA believes that the Simenstad report demonstrates that there is sufficient opportunity within the Commencement Bay and lower Puyallup River watershed to develop compensatory mitigation that also supports conservation of ESA-listed species. Final compensatory mitigation plans will follow the performance criteria discussed in Section IV.F.

D. Upland Regional Landfill

For the purposes of evaluating the upland regional landfill alternative, EPA identified two upland regional landfills that have the capacity to accept the possible dredging volume of Hylebos sediments: Roosevelt Regional Landfill near Goldendale, Washington, and Columbia Ridge Landfill near Arlington, Oregon. These sites are licensed Subtitle D commercial landfills. Bulk chemistry testing during pre-design indicates the sediments in areas other than "hot spots" (see Section II.C.) are suitable for disposal in a Resource Conservation and Recovery Act Subtitle D landfill for solid waste; additional testing will be done in design to confirm this. Both are approximately 200 miles from Tacoma. Dredged sediments would be offloaded landside into a confined stockpile/dewatering area. The location of this temporary disposal area has not yet been identified, however, there are vacant parcels on the shoreline in the vicinity of the dredging project that would provide sufficient capacity. Depending on the weather and water content of sediments, an extended period may be required for dewatering. The free water and interstitial water drained off during the rehandling process would be treated as necessary to meet water quality standards as required by the Clean Water Act and then discharged back to the waterway. After the sediment has been dewatered, it would be loaded into trucks, transported to a rail transfer facility, and transported to the landfill by rail. No compensatory mitigation is deemed owing for disposal of material into an upland regional landfill; although the requirement to avoid and/or minimize adverse impacts is still applicable.

E. Utilization of Disposal Sites

The City of Tacoma has recommended to EPA that the Thea Foss and Wheeler-Osgood contaminated sediments be placed in the St. Paul Nearshore Fill and, if possible, also the contaminated sediments from Middle Waterway. Blair Slip 1 and an upland regional landfill would then be used for the contaminated sediments from the Hylebos Waterway. EPA supports this mix but reserves the flexibility to allow the PRPs to make adjustments during design based on final disposal capacity, volumes, and timing. EPA also will continue to review disposal site designs to ensure that environmental impacts are minimized and unavoidable impacts are adequately compensated.

VII. STATUS OF SOURCE CONTROL

A. Background

The ROD recognized that the sources of contamination throughout the CB/NT Superfund site would have to be controlled before sediment cleanup could be achieved. The cleanup strategy for CB/NT has been to eliminate or reduce ongoing sources of problem chemicals to the extent practicable before implementing in-water cleanup actions. While Superfund is an effective tool to clean up existing contamination, other authorities are needed to address ongoing releases. Several federal, state and local programs were identified as tools to address source control independently of Superfund. In 1989, EPA and Ecology entered into an agreement that identified the Ecology

Commencement Bay Urban Action Team (UBAT) as lead for implementing source control actions. Ecology uses many regulatory tools to control sources, including the Model Toxics Control Act (MTCA) to address upland and groundwater sources and pollutant discharge permits under the Clean Water Act to address direct discharges to the waterways. Ecology reports its progress on the control of sources to EPA and consults with EPA on whether source control is sufficient to move forward with in-water clean up actions.

This ESD does not propose any changes to the source control strategy set forth in the 1989 ROD or the 1992 Source Control Strategy. However, additional information is provided below on how the strategy is being implemented at Thea Foss, Wheeler-Osgood, and Hylebos waterways.

The administrative mechanism used by Ecology to inform EPA of its progress on source control is a series of reports called Milestone Reports issued for each problem area identified in the ROD. There are five types of Milestone Reports and their purpose is as follows:

Milestone 1 - On-going Confirmed Sources Identified. Ecology has investigated and evaluated all potential sources, and identified all on-going, confirmed sources of problem chemicals.

Milestone 2 - Essential Administrative Actions in Place for Major Sources. Ecology has issued administrative actions, such as orders, consent decrees, or permits, to address major sources of problem chemicals in each problem area to ensure that they will be controlled to the extent necessary to prevent sediment recontamination. Major sources are those most directly linked with current sediment impacts.

Milestone 3 - Essential Remedial Action Implemented for Major Sources. Ecology has implemented all of the remedial actions, such as upland soil cleanup, adoption of best management practices, storm drain cleaning, etc., for all major sources. Essential remedial actions are those needed to eliminate or reduce those contaminant sources that are most likely to recontaminate sediments.

Milestone 4 - Administrative Actions in Place for All Confirmed Sources. Ecology has implemented all of the administrative actions discussed under Milestone 2 for all confirmed sources.

Milestone 5 - Remedial Action Implemented for All Sources. All essential source control work under the decrees, orders, or permits has been completed.

To date, Ecology has completed the following Milestone Reports for Hylebos, Thea Foss, and Wheeler-Osgood waterways:

Mouth of Thea Foss: Milestones 1 through 5
Head of Thea Foss: Milestones 1 and 2
Wheeler Osgood: Milestones 1 through 5

Mouth of Hylebos: Milestones 1 through 5
Head of Hylebos: Milestones 1 through 5

EPA expects that all Milestone Reports will be submitted and approved by the end of 2001.

The following sections provide more detailed information about completed and on-going source control actions at Thea Foss, Wheeler-Osgood, and Hylebos waterways. Because the nature of the sources of contamination are quite different between the Thea Foss/Wheeler-Osgood Waterways and the Hylebos Waterway, the types of source control implemented and issues associated with them are different. While much of the source identification and control work at all waterways has focused on working with individual facilities, Thea Foss Waterway has presented some unique challenges due to several large storm drains discharging into the waterway and multiple sources and deposits of NAPL.

B. Thea Foss and Wheeler-Osgood Waterways

Ecology identified numerous sources to the Thea Foss and Wheeler-Osgood waterways and took cleanup action. Some of the sources that were cleaned up include the following:

D Street Petroleum (groundwater at petroleum facility)
Superior Oil (groundwater at petroleum facility)
UNOCAL (groundwater at petroleum facility)
BP Oil (groundwater at petroleum facility)
Totem Marine Services (boat yard, hull washing)
Picks Cove (boatyard, hull maintenance, stormwater)
J.M. Martinac (shipyard, stormwater and sandblast grit on beach)
Marine Iron Works (storm drains)
West Coast Grocery (storm drains)
1147 Dock Street (bank contamination)
Chevron Bulk Plant (soils)
MPS/Truck Rail Handling (storm drains)
Kleen Blast (storm drains)
Olympic Chemical (groundwater)
City-owned parcels (various historical sources on west shore)

In addition to Ecology's efforts to control independent sources at Thea Foss and Wheeler-Osgood waterways, the City of Tacoma has been actively involved in controlling municipal sources by implementing the Stormwater Management Plan for Thea Foss Waterway. The program is required as part of the City's NPDES permit and lays out a step-wise, on-going process for characterization of effluent, identification and prioritization of potential chemical sources, actions to address sources, and monitoring and reporting on results. Under this program, the City of Tacoma has conducted hundreds of inspections, required businesses to implement best management practices, and required cleaning of stormwater drains, lines and catch basins. These actions, coupled with Ecology's efforts, have eliminated or reduced numerous significant sources of contamination to stormwater discharging to the waterway. A summary of the stormwater source control actions undertaken for the Thea Foss and Wheeler-Osgood waterways by the City of Tacoma is described in the Round 3 Data Evaluation and Pre-Design Evaluation Report.

While much progress has been made and many sources have been eliminated or reduced, source control is and will continue to be an ongoing prevention activity. Based on existing information, there continues to be some risk of recontamination of sediments towards the head of the Thea Foss Waterway if further actions are not taken to reduce sources of BEP (bis[2-ethylhexyl] phthalate) and PAHs (polycyclic aromatic hydrocarbons). Ecology still must select and implement a cleanup for the coal tar and creosote sources on the uplands at the head of the Thea Foss Waterway. The City of Tacoma also must implement further actions, including potential capital improvements to the municipal storm drains to reduce contaminant loadings to eliminate or significantly reduce the potential for recontamination of sediments. EPA and Ecology are working to ensure that appropriate controls are being applied to the stormwater sources considered likely to contribute to sediment recontamination. Additionally, in accordance with the ROD, results from the monitoring of sediments and effluent discharges will be used as feedback to the regulatory agencies who will monitor the effectiveness of source control actions. See Section IV for additional discussion about and specific requirements for source control.

C. Hylebos Waterway

Ecology identified 10 major ongoing sources to Hylebos Waterway sediment contamination:

Occidental Chemical Corporation (manufacturer of chlorine and chlorine-based chemicals)
Elf Atochem 3009 Taylor Way (inactive log sort yard)
Elf Atochem 2901 Taylor Way (former manufacturer of chlorine-based chemicals)
Kaiser Aluminum and Chemical Corp. (metal fabricator)
General Metals of Tacoma (metal scrap yard)
Wasser Winters (inactive log sort yard)
Louisiana Pacific (operating log sort yard)
Tacoma Boat (former large shipyard)
B&L Landfill (drains to Hylebos Creek)
Blair Backup Property (inactive log sort yard)

Essential source control actions have been completed for all of these facilities, as documented in Ecology's milestone reports for Mouth and Head of Hylebos Waterway.

In addition, Ecology identified 19 other ongoing sources of contamination to Hylebos Waterway sediments. Essential administrative actions (orders, decrees, or permits) are in place to address all of these sources of problem chemicals to Hylebos Waterway sediments, as documented in Ecology's November 1999 Milestone 4 reports for Mouth and Head of Hylebos Waterway. Ecology issued its Milestone 5 reports, documenting completion of source control for all Hylebos Waterway sources on June 14, 2000.

Ongoing sources of sediment contamination from these facilities have been addressed through a variety of permit and cleanup actions, including excavation and/or capping of upland contaminated soils, groundwater pump and treat, installation of sheet pile barrier walls, control of industrial and storm water discharges, and long-term monitoring programs. Appended to the Milestone 3 and 4 reports for the Head of Hylebos Waterway are evaluations of the effectiveness of groundwater and stormwater controls in preventing sediment recontamination after the completion of source control actions. These technical memoranda describe a conservative approach, based on data collected after source control actions have been completed, to estimating stormwater and groundwater contaminant loads to sediments. A similar analysis was completed for Mouth of Hylebos facilities in the Mouth of Hylebos milestone reports. The evaluation concluded that, in general, there was a very low risk of recontamination of Hylebos Waterway sediments from groundwater or stormwater discharges. Nonetheless, in accordance with the ROD, Ecology will continue to monitor and evaluate the effectiveness of source control actions.

VIII. SUPPORT AGENCY COMMENTS

Ecology concurs with this ESD. In particular, Ecology supports EPA's efforts to work with the Corps to integrate the Superfund cleanup on the Hylebos Waterway with a navigational dredging project and dredging for private development purposes. Ecology offered to explore grant funding opportunities to facilitate this additional dredging. Ecology is concerned about responsibility for oversight of navigational dredging of contaminated sediments after the Superfund cleanup. Finally, Ecology encourages EPA to begin cleanup in 2001.

The Puyallup Tribe also concurs with this ESD. However, the Tribe stated concerns about a number of things they believe need to be emphasized in the remedial design to support salmon recovery. These include:

a) emphasize permanence and long-term effectiveness in the cleanup design;
b) design intertidal cleanups to prevent or minimize habitat loss; and
c) avoid use of natural recovery as a cleanup method as much as possible.

The Tribe also stated their support for the bay-wide mitigation approach (see Section IV.F.) and providing "up-front" mitigation to address uncertainty in mitigation plans.

EPA will continue to coordinate with Ecology and the Puyallup Tribe to incorporate their concerns to the extent possible during remedial design and implementation of the cleanup. Concurrence letters from Ecology and the Puyallup Tribe are attached as Appendix B.

IX. AFFIRMATION OF THE STATUTORY DETERMINATION

Considering the new information that has been developed in this ESD and in the Administrative Record, EPA believes that the cleanup plan is and will be protective of human health and the environment, complies with Federal, State and Tribal requirements that are applicable, or relevant and appropriate to this remedial action as identified in the ROD (with the addition of ESA), and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this site. However, because treatment was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principle element. Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review will be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

X. PUBLIC PARTICIPATION ACTIVITIES

EPA has held regular public meetings and has issued many fact sheets to update the public on its activities since the ROD was signed in 1989. Because the selection of disposal sites was of particular interest to the public, EPA has held a series of "Disposal Sites Forum" meetings since 1996. In these meetings, options for sediment disposal were discussed with members of the public, government agencies, Native American tribes, environmental groups, and industry representatives. The group developed a list of candidate sites considered "most promising" for sediment disposal. All of the sites that were considered by EPA are on that list.

EPA mailed a fact sheet and held a 45-day public comment period from July 1, 1999 to August 16, 1999 on its proposed refined list of disposal sites. The refined list included four sites. Approximately 100 people attended a public meeting on June 21, 1999 to discuss the refined list, as well as the latest information on source control and the waterway cleanup plans. EPA also held two meetings with homeowners who live near the location of the proposed Mouth of Hylebos disposal site on July 28, 1999 and November 3, 1999, for a more detailed discussion of that disposal site. On January 12, 2000, Chuck Clarke, EPA's Regional Administrator, met with residents of Marine View Drive to hear their concerns about the proposed Mouth of Hylebos disposal site.

EPA considered the comments received from the public in developing the draft ESD. EPA received more than 20 letters commenting on the June 1999 fact sheet. Many letters urged EPA to move forward with the cleanups of the waterways and to select the St. Paul Nearshore Fill site as a disposal site. There were also letters expressing opposition to the Mouth of Hylebos disposal site. The issues raised in these letters included concerns about noise during construction, concerns about construction activities impeding water access, the site's geologic stability, the impact on property values, the potential effect on the drinking water supply, the impact on homeowner views, and others. EPA also received comments from a number of people who support disposal on state-owned aquatic lands and who urged use of a CAD site.

EPA mailed a fact sheet describing the draft ESD to 1300 people. A public comment period was held from November 29, 1999 to January 3, 2000. Over 100 people attended a public meeting held by EPA on December 8, 1999 to discuss its proposal and take comments from the public. A request for an extension to the comment period was received, and the date to submit public comment was extended until February 2, 2000.

EPA received 180 comment letters during the public comment period. Many letters expressed opposition to the proposed Mouth of Hylebos disposal site and to the proposed cleanup action at the head of the Thea Foss Waterway. Comments were received from the Puyallup Tribe and from state and federal resource agencies who expressed concerns related to the specific cleanup plans and mitigation proposed under the Clean Water Act.

As a result of the opposition to this proposed site, a group of potentially responsible parties called Partnership for a Clean Waterway (PCW) hired a consultant, Merritt & Pardini, to conduct a series of workshops to look for creative solutions to the cleanup of the Hylebos Waterway. Three workshops were held from March through June 2000. The workshops brought together federal, state, and local agencies, the tribes, and interested community members to identify concerns and explore alternatives to the Mouth of Hylebos CAD site. EPA attended all of the meetings, and the information has been considered for the final decision in this ESD. EPA has placed the recommendations that resulted from the Merritt-Pardini workshops in the administrative record. In particular, EPA has incorporated the recommendations to maximize the capacity of Blair Slip 1 to the extent practicable and to allow further consideration of upland disposal on an upland parcel(s) of property if implementable and in compliance with any ARARs.

A summary of the comments received during the public comment period and EPA's responses is included as Appendix C to this ESD.

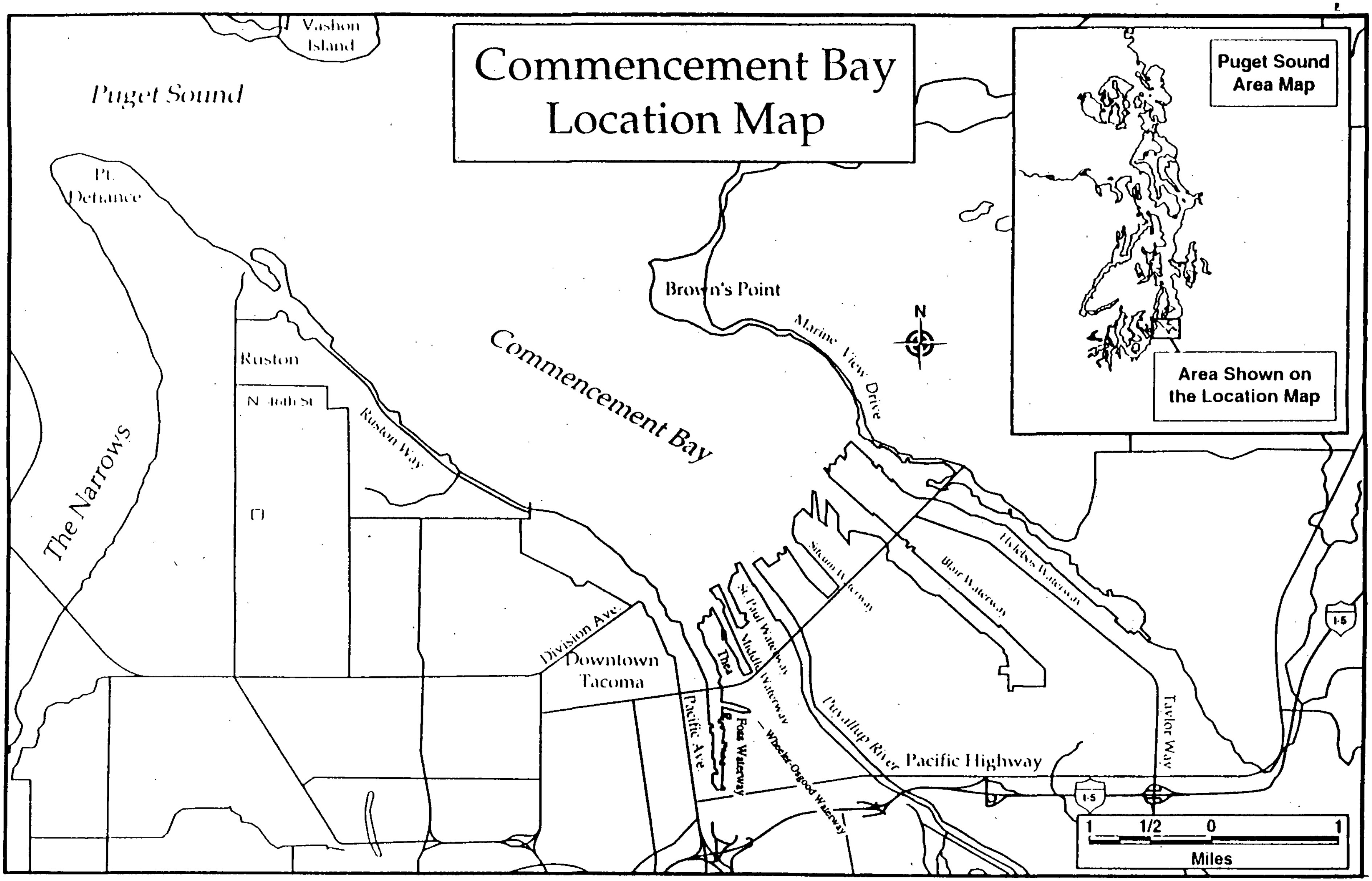
Signed:

Michelle Pirzadeh for — 8/3/00

Michael F. Gearheard, Director — Date
Office of Environmental Cleanup

Appendices

A Cost Summaries for the Hylebos, Thea Foss and Wheeler Osgood Waterway Remedial Actions
B State of Washington Concurrence Letter
Puyallup Tribe of Indians Concurrence Letter
C Responsiveness Summary



Commencement Bay
Location Map
Puget Sound
Vashon Island
Pt. Defiance
Ruston
N 46th St
Ruston Way
The Narrows
Commencement Bay
Brown's Point
Marine View Drive
N
Puget Sound Area Map
Area Shown on the Location Map
Division Ave.
Downtown Tacoma
Pacific Ave.
Thea Foss Waterway
Wheeler-Osgood Waterway
Middle Waterway
St. Paul Waterway
Sitcum Waterway
Blair Waterway
Hylebos Waterway
Puyallup River
Pacific Highway
Taylor Way
I-5
1 1/2 0 1
Miles

Figure 1

Major SSMA Divisions

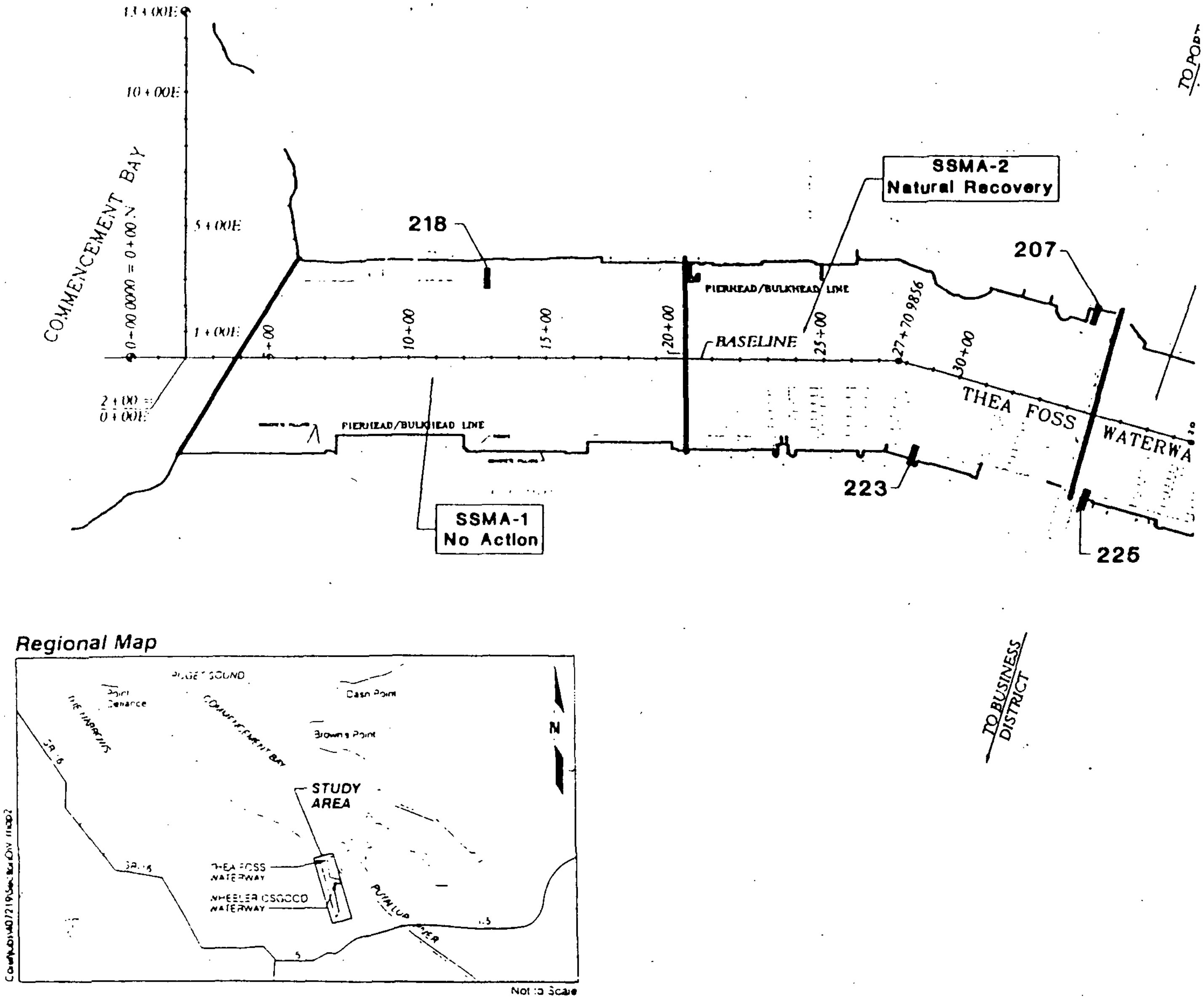
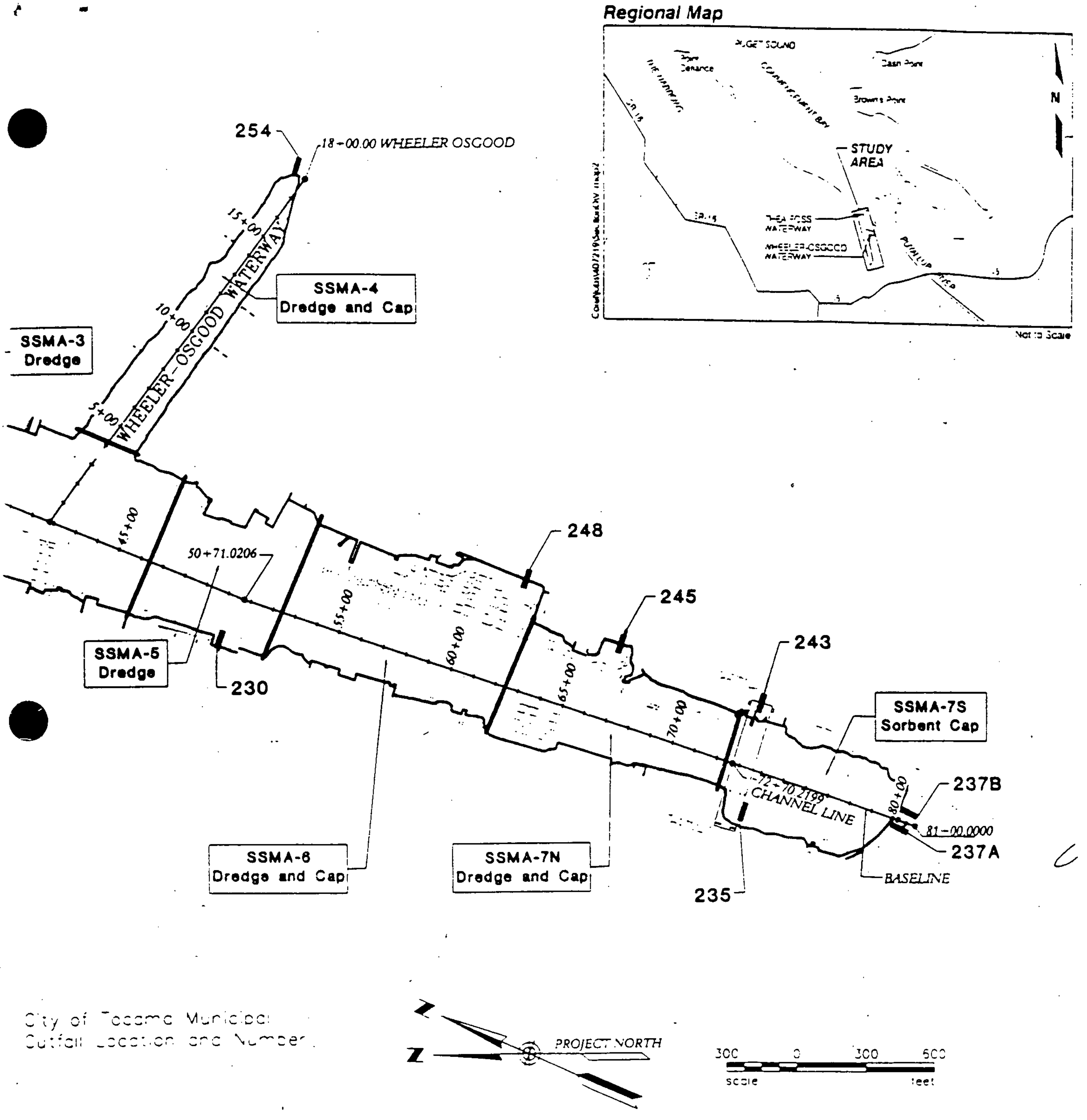


Figure 2A
Thea Foss Waterway Cleanup Area



HARTCROWSER

Figure 2B

Thea Foss and Wheeler Osgood Waterways Cleanup Areas

SSMA 7 Proposed Remedial Design

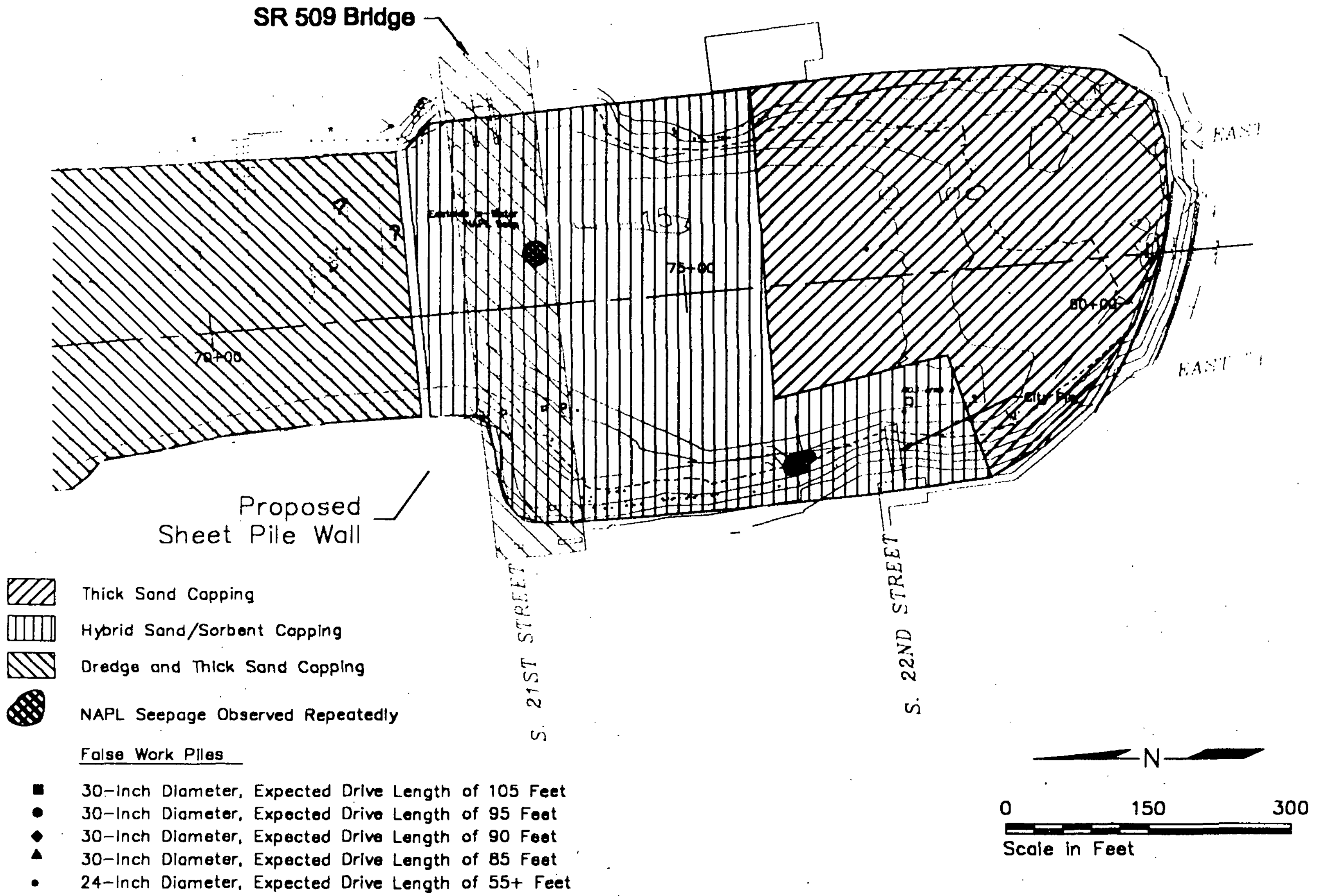
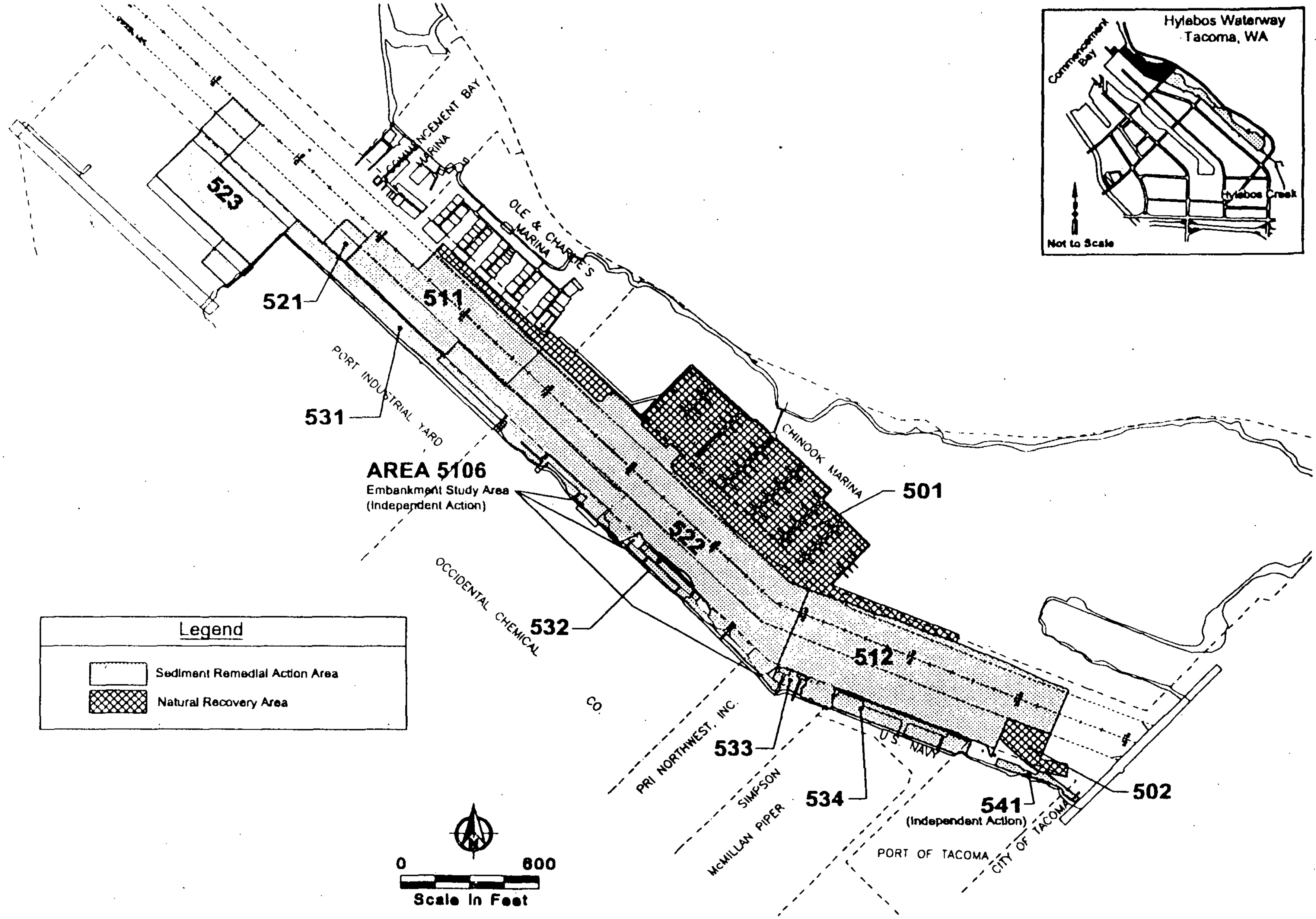


Figure 2C

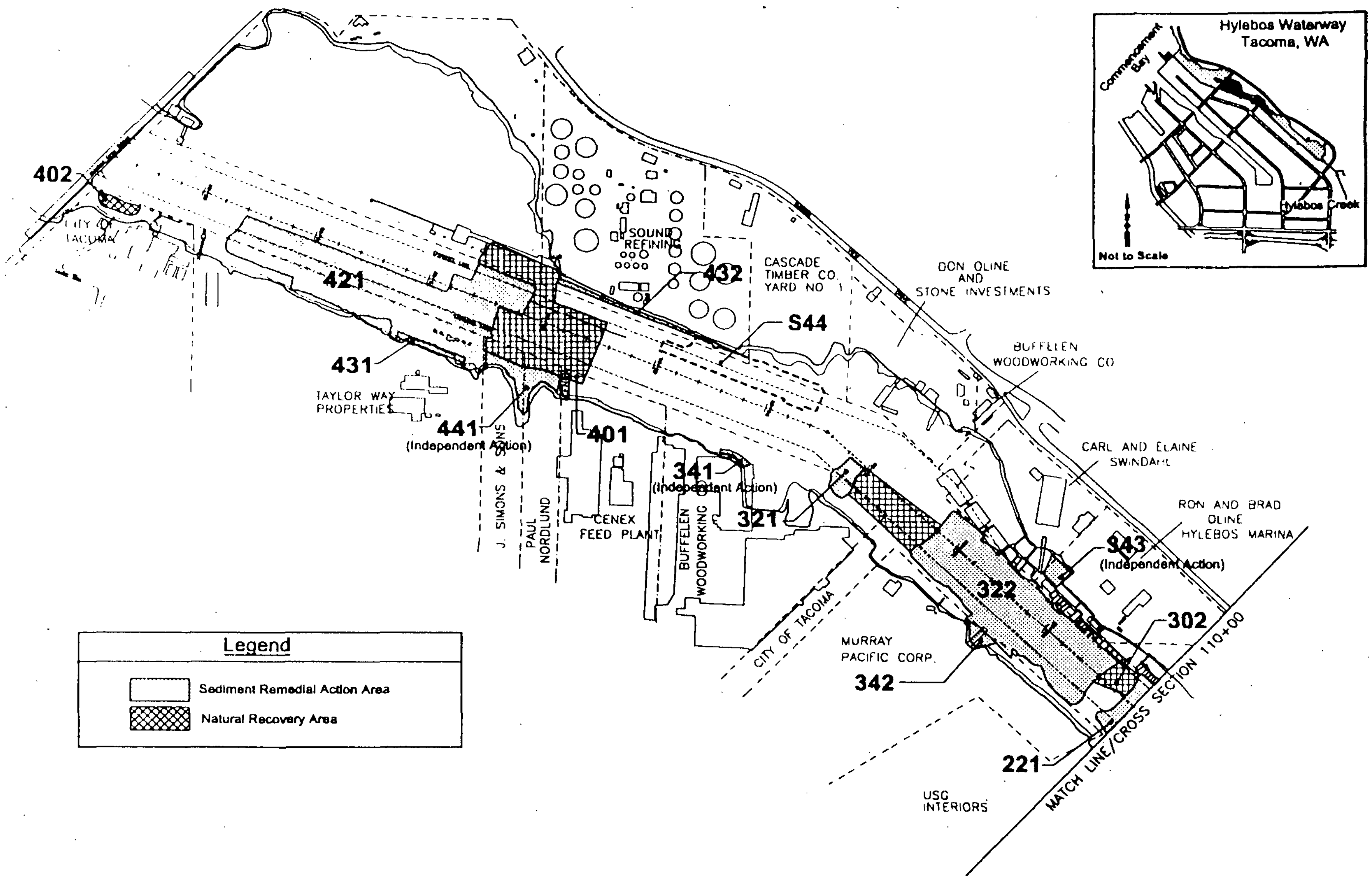
Head of Thea Foss Waterway



10/20/99

Figure 3A

Hylebos Waterway Cleanup Areas



Legend

	Sediment Remedial Action Area
	Natural Recovery Area

0 600
Scale in Feet

10/20/99

Figure 3B
Hylebos Waterway Cleanup Areas

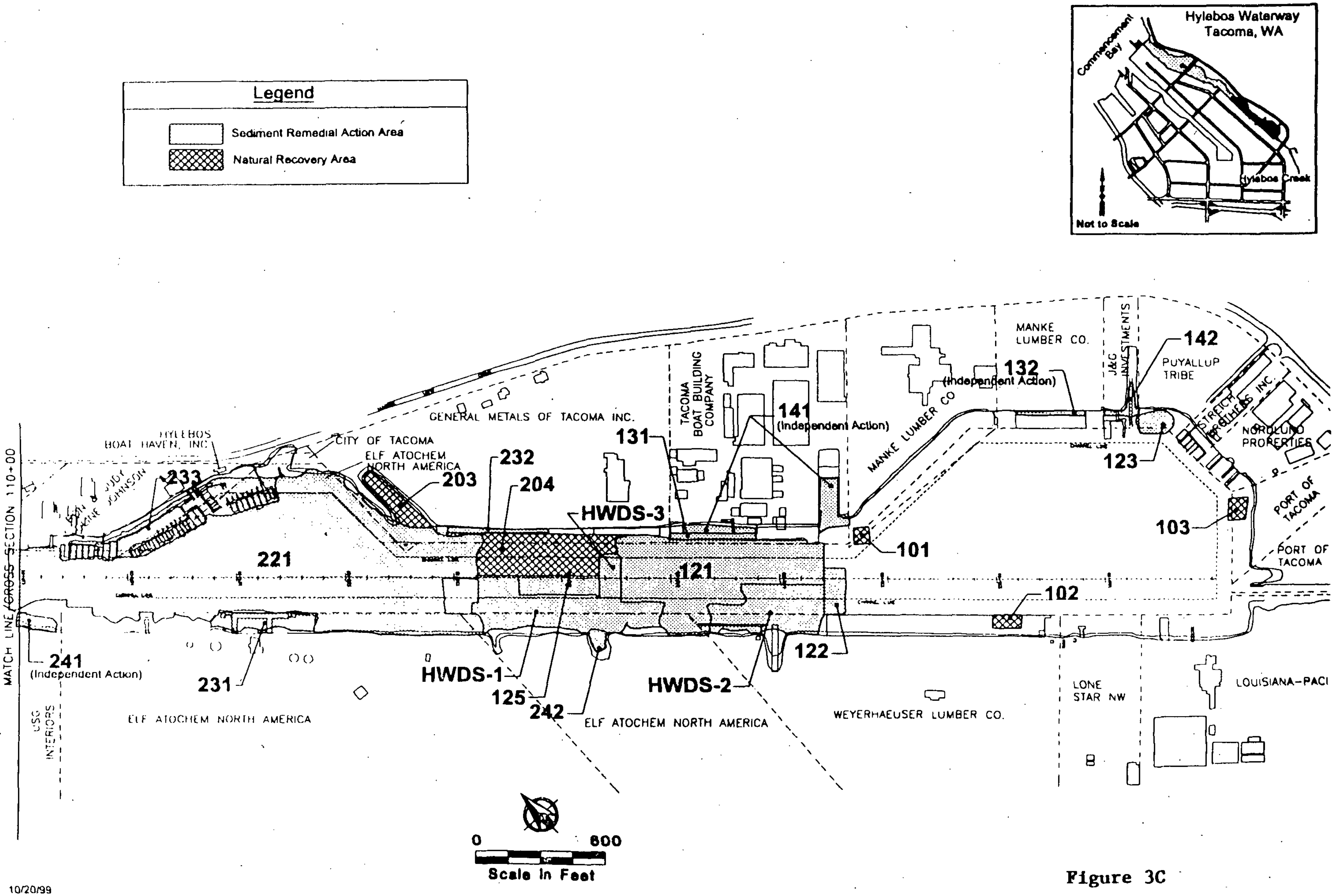


Figure 3C

Hylebos Waterway Cleanup Areas

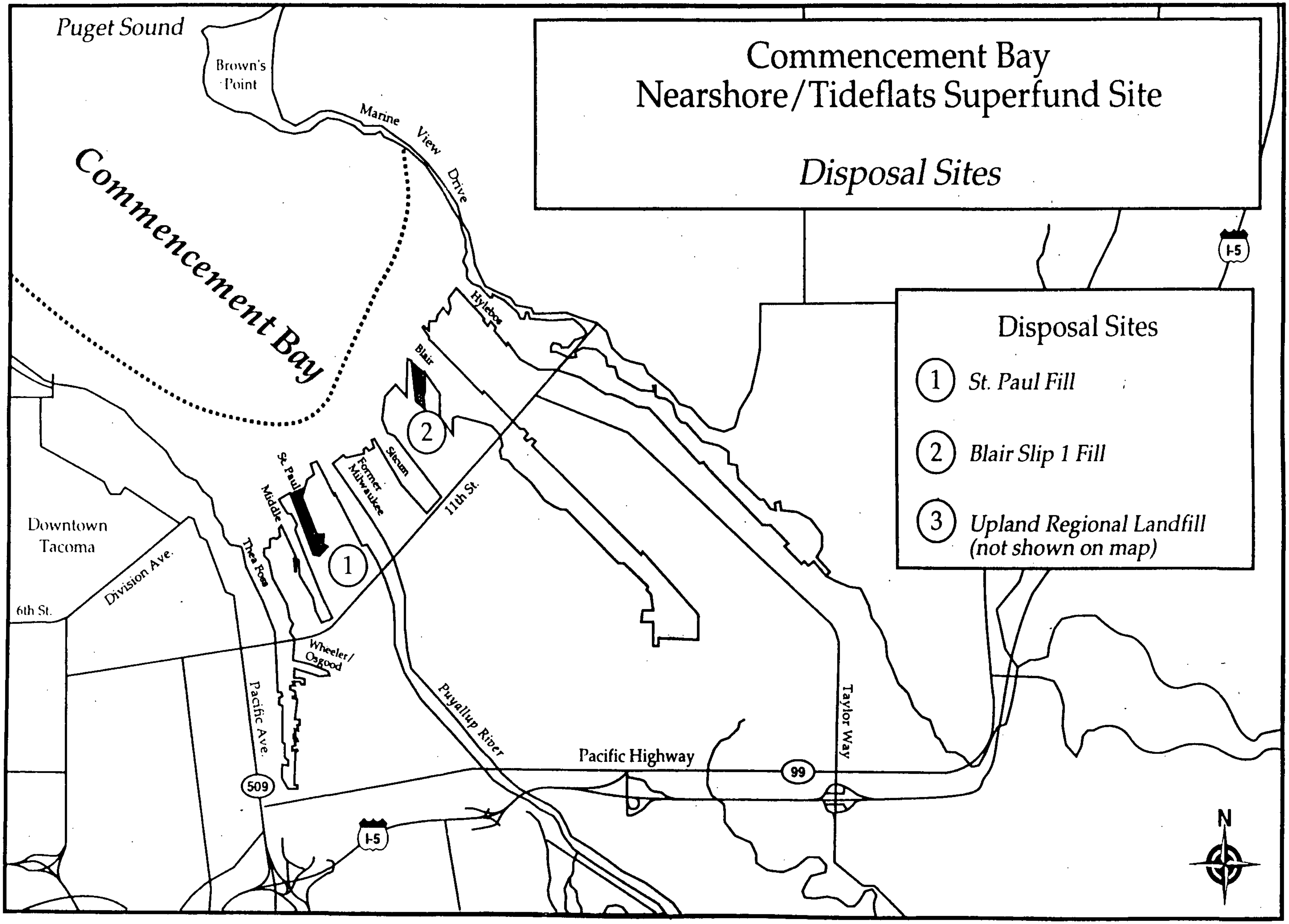

Commencement Bay
Nearshore/Tideflats Superfund Site
Disposal Sites
Disposal Sites
1 St. Paul Fill
2 Blair Slip 1 Fill
3 Upland Regional Landfill
(not shown on map)
Puget Sound
Brown's Point
Marine View Drive
Commencement Bay
Hylebos
Blair
2
St. Paul
Middle
Former Milwaukee
Sitcum
11th St.
1
Thea Foss
Downtown Tacoma
Division Ave.
6th St.
Wheeler/Osgood
Pacific Ave.
Puyallup River
Pacific Highway
Taylor Way
99
509
I-5
I-5
N

Figure 4

Appendix A

Cost Summaries for the Hylebos, Thea Foss and Wheeler Osgood Waterway Remedial Actions

Table A-1. Cost of Dredging Hylebos Waterway Sediments and Disposal in Blair Slip 1 (640,000cy)

Category Disposal Site 640,000 CY	Quantity	Unit	Unit Cost ($)	Cost ($)
Disposal Site Development				
Mobilization and Demobilization				
Pier Demolition Equipment	1	LS	50,000.00	50,000
Clamshell Equipment	1	LS	200,000.00	200,000
Hydraulic Equipment	1	LS	100,000.00	100,000
Site Preparation				
Pier Demolition	6,600	TON	150.00	990,000
Temporary Facilities (Relocate Facilities, Lighting, Site Office)	1	L.S.	250,000.00	250,000
Berm Foundation Excavation and Disposal at PSDDA Site				
Clamshell and Bottom-Dump Barge	45,000	CY	7.50	338,000
DNR Disposal Site Use Fee	45,000	CY	0.45	20,000
Berm Construction w/Imported Crushed Material				
Bottom-Dump Barge (-50 feet to -5 feet)	76,000	CY	14.00	1,064,000
Haul Barge and Clamshell (-5 feet to +18 feet)	25,000	CY	17.00	425,000
Berm Outer Slope Riprap, 2 feet Thick (Class II)	10,400	Ton	20.00	208,000
Place 7-foot Cap with Sand from Puyallup River by Hydraulic Dredge				
Hydraulic Dredging	180,000	CY	5.00	900,000
DNR Sand Purchase Cost	180,000	CY	3.19	574,000
Budget Allowance to Install Wick Drains	1	LS	1,000,000.00	1,000,000
Water Quality Monitoring	1	LS	250,000.00	250,000
Surveying	1	LS	145,000.00	145,000
Mitigation and Monitoring <5>	1	LS	3,350,000.00	3,350,000
Long-Term Monitoring and Maintenance <2>	1	LS	760,000.00	760,000
Land Acquisition <3>	1	LS	0.00	-
Cost Subtotal				10,624,000
Engineering & Design			15%	1,594,000
Contingency			20%	2,125,000
Total Estimated Disposal Site Cost <1>				14,343,000

Source: Hylebos Waterway Pre-Remedial Design Evaluation Report, Hylebos Cleanup Committee, November, 1999.

Table A-1 (continued)

Category Disposal Site 640,000 cy	Quantity	Unit	Unit Cost ($)	Cost ($)
Dredging and Disposal				
Dredge Hylebos Waterway Sediment (See Section 6)				
and Dispose of at Site 12 <4>				
Clamshell and Bottom-Dump Barge	354,000	CY	6.50	2,301,000
Clamshell and Rehandling w/Derrick and Flat-Deck Barge (Fill above -5 feet)	286,000	CY	12.50	3,575,000
Dredging and Disposal Subtotal				5,876,000
Engineering and Design			15%	881,000
Construction Oversight and Monitoring				
by HCC Authorized Representative	1	LS	250,000.00	250,000
Contingency			20%	1,175,000
Dredging and Disposal Cost Total				8,182,000
Total: Disposal Site Development and Dredging and Disposal Cost <1>				22,525,000

<1>The estimated cost for construction of Nearshore CDF 12 (Slip1) includes all anticipated construction-related costs, without consideration of whether the costs are commercial development costs associated with the Port of Tacoma's proposed filling of Slip 1 to expand its existing marine container facility, or CERCLA response costs associated with the handling and disposal of Hylebos dredged sediments.

<2> Long-term monitoring monitoring and maintenance costs were calculated based on the Confined Disposal Site Study, Programmatic EIS. Draft, February, 1999.

<3> No cost for land acquisition, if any, is included in this cost estimate.

<4> Cost does not incude dredging under floating docks and fixed structures.

<5> Mitigation costs provided by Port of Tacoma (9/24/99 Memo to HCC), based on the Port's proposed mitigation plan for Terminal 3/4 Northern Expansion Plan (PIE, December 22, 1998)

Table A-2. Cost of Dredging Hylebos Waterway Sediments and Disposal in an Upland Regional Landfill (300,000cy)

Category Dredge and Dispose 300,000 cy Sediment	Quantity	Unit	Unit Cost ($)	Cost ($)
Mobilization	1	LS	250,000.00	250,000
Dredge Sediment (Clamshell) from Hylebos Waterway Problem Areas, and Off-Load to a Land-Side Stockpile Area <1> <2>	300,000	CY	9.60	2,880,000
Dewater Sediment <3>	300,000	CY	1.20	360,000
Load Sediment into Waste Management Gondola Cars	300,000	CY	1.00	300,000
Transport to Regional Landfill and Dispose	450,000	Ton	30.00	13,500,000
Monitoring During Construction	1	LS	200,000.00	200,000
Mitigation	1	LS	N/A	N/A
Long-Term Monoitoring and Maintenance	1	LS	N/A	N/A
Land Acquisition	1	LS	N/A	N/A
Cost Subtotal				17,490,000
Engineering & Design			15%	2,624,000
Contingency			20%	3,498,000
Total Estimated Dredging and Disposal Site Cost = Project Cost				23,612,000

<1> Cost Estimate does not include dredging under floating docks and fixed structures.

<2> Cost estimate does not include land easement, if any, for stockpile site.

<3> Cost estimate includes barrier, impermeable liner, runoff water collection and disposal.

Source: Hylebos Waterway Pre-Remedial Design Evaluation Report, Hylebos Cleanup Committee, November, 1999.

Table A-3 Preliminary Engineer's Cost Estimate of Waterway Remediation Alternative 5B with Disposal at the St. Paul Nearshore Facility

TASK	QUANTITY	UNIT	UNIT COST		COST
PRE-CONSTRUCTION					
Mobilization/Demobilization	1	EA	$550,000	$	550,000
Baseline Water Quality Survey	1	EA	$100,000	$	100,000
Pre- and Post-Dredge Surveys	2	EA	$25,000	$	50,000
NEARSHORE FACILITY CONSTRUCTION					
Disposal Facility Preparation					
Remove and Dispose of Piling	400	EA	$200	$	80,000
Site, Building, and Utility Demolition	1	EA	$190,000	$	190,000
Deepen Nearshore Facility and Construct Berm					
Berm Construction below Elev. -5 ft MLLW	167,000	CY	$5.25	$	876,800
Berm Construction above Elev. -5 ft MLLW	23,000	CY	$8.00	$	184,000
Installation of Overflow Weirs	2	EA	$40,000	$	80,000
Construction of Perimeter Berm	7,500	CY	$8.00	$	60,000
Cap Nearshore Fill Site to Finished Subgrade					
Middle Waterway Excavated Material	90,000	CY	$4.00	$	360,000
Off-Site Dredge Material	42,500	CY	$8.75	$	371,900
Perimeter Berm Material	7,500	CY	$0.50	$	3,800
Site Mitigation/Restoration					
Remove and Dispose of Piling	1,370	EA	$200	$	274,000
Final Contouring of Tidal Channel in Middle Waterway	90,000	CY	$0.50	$	45,000
Final Contouring of St. Paul Habitat	100,000	CY	$0.50	$	50,000
Habitat Material Dredged from St. Paul	273,000	CY	$5.25	$	1,433,300
High Marsh Grading and Planting	1	EA	$100,000	$	100,000
Rock-lined Berm Construction (High Marsh)	3,000	CY	$24.00	$	72,000
Intertidal Reef (Riprap)	4,000	CY	$40.50	$	162,000
Freshwater Wetland Excavation/Diversion					
Vinyl Sheet Pile with Granular Fill	2,000	LF	$285	$	570,000
Excavation and Disposal/Reuse	30,000	CY	$8	$	240,000
Freshwater Wetland Grading and Plantings	1	EA	$60,000	$	60,000
Breach Dike	1	EA	$200,000	$	200,000
Freshwater Supply (Rehabilitate abandoned City line)	2,500	LF	$25	$	62,500
Logs	500	LF	$210	$	105,000
Ecology Blocks	2,000	LF	$115	$	230,000
DREDGE, HAUL, AND DISPOSE OF AT NEARSHORE FILL SITE [1]					
Hydraulic Dredge					
Channel	460,000	CY	$5.25	$	2,415,000
Slopes	135,000	CY	$5.75	$	776,300
WATERWAY CAPPING[1]					
Channel Areas - *In Situ* and Thick Cap over Dredge Cuts	105,000	CY	$8.75	$	918,800
Slope Areas					
Slope Protection Filter	82,000	CY	$25.00	$	2,050,000
Slope Quarry Spalls	18,000	CY	$24.00	$	432,000
Slope Riprap	3,000	CY	$40.50	$	121,500
RELATED CONSTRUCTION					
Construct Temporary Marinas	1	LS	$45,000	$	45,000
Remove and Replace Marinas	113,000	SF	$5.00	$	565,000
Remove and Dispose of Debris	1	LS	$25,000	$	25,000
Regrade Sediments at Head of Waterway	2,000	CY	$0.50	$	1,000
Armor Twin 96-inch Outfalls	1	LS	$110,000	$	110,000
Remove and Replace Piling	50	EA	$2,500	$	125,000
Remove and Replace Outfalls	5	EA	$10,000	$	50,000
Miscellaneous Demolition and Slope Work	1	EA	$200,000	$	200,000
SSMA 7 REMEDIATION (see Table N-19)[2]	1	LS	$12,317,400	$	12,317,400
CONSTRUCTION SUPPORT					
Construction Management (See Table N-10)	56	WKLY	$10,000	$	560,000
Water Quality Monitoring (See Table N-10)					
Intensive	19	WKLY	$20,000	$	380,000
Routine	37	WKLY	$14,000	$	518,000
Bathymetric Surveys (Thea Foss Waterway) (See Table N-10)	1	LS	$57,500	$	57,500
Bathymetric Surveys (St. Paul Neashore Fill Site) (See Table N-10)	1	LS	$23,800	$	23,800
Post-Dredge Sediment Sampling and Analysis (See Table N-10)	1	LS	$51,800	$	51,800
Monitoring Wells (St. Paul Nearshore Fill Site) (See Table N-10)	3	LS	$10,000	$	30,000
LONG-TERM MONITORING (Present Worth)					
Thea Foss Waterway Monitoring	1	LS	$80,300	$	80,300
St. Paul CDF Monitoring	1	LS	$300,000	$	300,000
St. Paul CDF Contingency Reserve	1	LS	$630,000	$	630,000
Habitat Monitoring and Adaptive Management					
Including Middle Waterway and Puyallup Wetland)	1	LS	$682,000	$	682,000

SUBTOTAL: $ 29,975,700
CONTINGENCY @ 20%: $ 5,995,200
TOTAL ESTIMATED COST: $ 35,970,000

Notes

407225/Round3/AppendixN.xls

Source: Round 3 Data Evaluation and Pre-Evaluation Report, City of Tacoma, 1999

Note: This table includes the cost of a slurry wall at the head of Thea Foss Waterway, which has been excluded from EPA's selected remedy. Exclusion of the slurry wall reduces the cost of the remedy to approximately $35 million.

Appendix B

State of Washington Concurrence Letter
Puyallup Tribe of Indians Concurrence Letter

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

RECEIVED

JUL 21 2000

Environmental Cleanup Office

July 17, 2000

Ms. Lori Cohen
EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101

Dear Ms. Cohen:

The Department of Ecology (Department) has reviewed EPA's Explanation of Significant Differences (ESD), dated June 2000, for the Commencement Bay Nearshore/Tideflats Superfund Site. The ESD describes the cleanup plans for Hylebos, Thea Foss, and Wheeler-Osgood Waterways. The Department concurs with the ESD.

The Department appreciates EPA's willingness to work with private parties and the Army Corps of Engineers to integrate navigational dredging into the remedial design schedule, if there is interest by the private parties. The Department also appreciates EPA's statement encouraging private property owners and waterway users to consider any current or future additional dredging needs and to alert EPA. The Department continues to be available to help with this endeavor, including potential grant funding to local public entities that provide financial support to navigational dredging. The Department will not assume responsibility for overseeing navigational dredging of Hylebos sediments contaminated at depth above levels suitable for open water disposal under PSSDA. The Department maintains that such responsibility remains with EPA under CERCLA.

In addition, the Department has reviewed EPA's revised estimate for the residual PCB level in Hylebos Waterway post-remediation ("Recalculation of Residual PCB Concentrations in Commencement Bay Sediment", undated). The Hylebos remedy selected in the 2000 ESD assumes that at least 940,000 cubic yards of sediment will be removed from the waterway, whereas the 1997 ESD assumed only 508,000 cubic yards of sediment would be removed. Because considerably more PCB's will be removed than anticipated in 1997, the residual PCB level that EPA expects to achieve is now 28% below the level selected in the 1997 ESD and 14% below the level originally proposed in the 1989 Record of Decision. These calculations are based on area-weighted averages for

Hylebos Waterway. The Department concurs with this analysis and the new cleanup goal, assuming additional active remediation would take place if the goal were not achieved 10 years after cleanup.

EPA should continue to push for a 2001 start for active remediation and we will assist as we can to see that goal realized.

Sincerely,

James J. Pendowski, Manager
Toxics Cleanup Program

JJP:nh

Puyallup Tribe of Indians

Allison Hiltner
US EPA Region 10
1200 Sixth Ave
Seattle, WA 98101

RECEIVED
JUL 24 2000
Environmental Cleanup Offi

Re: Concurrence on Explanation of Significant Differences (ESD) Commencement Bay Nearshore Tideflats Superfund Site.

Dear Allison:

Thank you for taking the time and meeting with me to review the above referenced document. With this letter, the Puyallup Tribe concurs on the ESD for clean up of Hylebos and Thea Foss/Wheeler Osgood waterways and disposal site selection for the CB/NT Superfund Site.

Although the Puyallup Tribe supports the cleanup of contaminated sediments from the Hylebos and Thea Foss/Wheeler Osgood waterways, we have numerous concerns regarding the menu of proposed methodologies to achieve cleanup.

As stated in our 1/31/00 comment letter to your agency, the Puyallup Tribe of Indians are the indigenous people of Commencement Bay who still rely on the aquatic resources of this embayment for subsistance as well as cultural and spiritual health. Additionally, the Tribe owns valuable economic properties on the Hylebos and Blair waterways. The ultimate success of this cleanup means more to this Tribe than another entity.

The recovery of salmonid stocks will continue to be in jeopardy if the cleanup remedy fails. The Tribe insists that during remedial design, EPA places a higher preference on permanent long-term effective cleanup. All Intertidal cleanup must be designed to prevent habitat loss. The reliance on Natural recovery, particularly in Hylebos waterway needs to be minimized. The Puyallup tribe remains unconvinced that natural recovery can be achieved in an active navigational waterway.

Finally, the Tribe fully supports the two in water disposal sites identified in the ESD. The mitigation is adequate but the Tribe has some concern regarding the "uncertainty factor" as it relates to the Simpson proposal. The Tribe feels that this uncertainty factor is true for all mitigation and restoration projects undertaken in Commencement Bay. As part of the CWA section 404 and ESA salmon recovery, the Tribe believes that this factor should be applied Baywide and that EPA and the Natural Resource Agencies support the option of establishing up front additional mitigation either through an additional project or a mitigation bank to develop a project located in the river node area identified in the Baywide habitat assessment.

In conclusion, the Puyallup Tribe of Indians concurs with the final ESD. However, the Puyallup Tribe encourages the EPA to work with the PRP's during remedial design to achieve cleanup solutions that will be the most protective of human health and the natural resources of Commencement Bay. The Tribe looks forward to the cleanup of these waterways and remains supportive of EPA's efforts.

Sincerely,

Bill Sullivan

Bill Sullivan
Director of Natural Resources &
Environmental Programs

Cc Tribal Council
Fisheries
Legal
Files

2002 East 28th Street • Tacoma, Washington 98404 • 206/597-6200

Appendix C
Responsiveness Summary

CB/NT ESD RESPONSIVENESS SUMMARY

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

LIST OF ACRONYMS

AET	apparent effects threshold
AKART	all known and reasonable treatment
ARARs	applicable, or relevant and appropriate requirements
BA	Biological Assessment
BEP	bis-2-ethylhexyl phthalate
BMPs	best management practices
CAD	confined aquatic disposal
CBN/T	Commencement Bay Nearshore/Tideflats
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulation
CHB	Citizens for a Healthy Bay
COCs	contaminants of concern
cy	cubic yards
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DMMP	Dredged Materials Management Program
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESD	Explanation of Significant Differences
HCC	Hylebos Cleanup Committee
HPAHs	high molecular weight PAHs
LNAPL	light non-aqueous phase liquid
LPAHs	low molecular weight PAHs
MCUL	minimum cleanup level
MLLW	mean lower low water
MLs	maximum levels
MTCA	Model Toxics Control Act
MUDS	multi-user disposal site
MWAC	Middle Waterway Action Committee
NAPL	non-aqueous phase liquid
NCP	National Contingency Plan
NEPA	National Environmental Policy Act of 1969
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OMMP	Operations, Maintenance, and Monitoring Plan

PAHs	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyls
PCW	Partnership for a Clean Waterway
PDI	physical disturbance index
PMA	Port Management Agreement
ppb	parts per billion
PRDER	Pre-Remedial Design Evaluation Report
PRPs	Potentially Responsible Parties
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SAP	sampling and analysis plan
SMAs	Sediment Management Areas
SQOs	sediment quality objectives
SRAL	Sediment Remedial Action Level
SSMA	Superfund Sediment Management Area
USFWS	U.S. Fish and Wildlife Service
WASP	Water Quality Analysis Simulation Program
WDFW	Washington State Department of Fish and Wildlife
WDG	Wood Debris Group
WDNR	Washington State Department of Natural Resources
WDOT	Washington State Department of Transportation
WRDA	Water Resources Development Act

1.0 OVERVIEW

The purpose of this responsiveness summary is to summarize and respond to public comments submitted to EPA on the draft Explanation of Significant Differences (ESD) to the Record of Decision (ROD) for the cleanup of the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site. This responsiveness summary has been prepared in accordance with Section 117 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and July 1999 guidance document entitled *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (EPA 540-R-98-031). The public comment period was held from November 29, 1999 to February 2, 2000. A public meeting was held on December 8, 1999 to present the draft ESD and to accept oral and written public comments. The meeting was attended by over one hundred people.

A number of issues were raised by attendees at the public meeting who expressed opposition to the proposed Mouth of Hylebos confined aquatic disposal (CAD) facility and to the proposed cleanup action at the head of the Thea Foss Waterway. Questions that were answered at the public meeting were recorded in the meeting transcript, which is available in the Administrative Record for the site. Those questions are not included in this responsiveness summary. Formal comments made at the public meeting are included in the responsiveness summary.

One hundred-eighty comment letters were received from citizens during the public comment period. The majority of the commentors presented concerns similar to those expressed at the public meeting. In addition, comments were received from the Puyallup Tribe (Tribe) and from state and federal resource agencies who expressed concerns related to the specific cleanup plans and mitigation proposed under Section 404 of the Clean Water Act.

The following responsiveness summary is presented by waterway, with specific topics called out within each waterway section. Topics applicable to Commencement Bay as a whole are provided last. Comment numbers corresponding to comment letters received during the public comment letter are provided at the end of specific comments.

1.1 Changes to the Proposed ESD

In response to significant public comment on EPA's proposed selection of disposal sites and other elements of the selected remedies, EPA has:

- Withdrawn the Mouth of Hylebos CAD as a disposal site;
- Required both nearshore fill disposal sites, St. Paul Waterway and Blair Slip 1, to be maximized for disposal of contaminated sediments from the CB/NT site to the extent practicable;
- Identified use of an upland regional landfill for disposal of contaminated sediment;
- Allowed further analysis of upland disposal within the CB/NT site boundaries during remedial design for EPA's consideration and approval as a means to lower disposal costs;
- Modified the cleanup plan for Thea Foss Waterway, especially the remedy for the head of the waterway;
- Modified the stormwater performance criteria for the Thea Foss Waterway; and
- Specified performance criteria for compensatory mitigation

EPA has incorporated these changes into the final ESD for the remedial actions at the Thea Foss and Hylebos waterways and selection of disposal sites for the CB/NT Site. More information regarding these changes are provided in this responsiveness summary. EPA received numerous comments about the proposed Mouth of Hylebos CAD site. Even though EPA did not select the

CAD in the final ESD, EPA has responded to the comments on the CAD in the responsiveness summary.

2.0 HYLEBOS WATERWAY

2.1 General Comments about Hylebos CAD Disposal Facility

Comment 1: Many comments were received opposing the Mouth of Hylebos CAD facility due to its proximity to nearby residences and as an inappropriate use of state-owned aquatic land. A few commentors supported its selection as a practical alternative to move the Hylebos Waterway cleanup forward.

I strongly oppose the Hylebos mouth CAD. [18] [24] [79] [93] [105] [106] [107] [108] [109] [110] [111] [112] [113] [114] [115] [116] [117] [118] [119] [120] [121] [122] [123] [124] [125] [126] [127] [128] [129] [130] [131] [132] [133] [134] [135] [136] [137] [138] [139] [140] [141] [142] [143] [144] [145] [146] [147]

As I understand it, the justification for the Mouth of Hylebos CAD site proposal is that the detritus from decades of log storage would be cleared up at the same time. Given the local current, sedimentation and biological processes I have observed over the years, I would speculate that if the log rafts were removed, the detritus problem would resolve itself naturally over a short period of time. [174]

We are writing to ask you to reconsider the proposal to use the mouth of the Hylebos Waterway as a CAD site for approximately two million cy of contaminated sediments from within the waterway. The United States Environmental Protection Agency (EPA) is considering a proposal to construct a 33-acre CAD facility adjacent to Marine View Drive and close to residential homes. We believe there are significant problems with the choice of that site and that better cleanup alternatives exist. [12]

Until such time as the availability of CAD sites and other substantive issues are resolved with Washington State Department of Natural Resources (DNR), Middle Waterway Action Committee (MWAC) continues to oppose any effort by EPA to settle DNR's liability for the CBN/T site or any of its problem areas. [152]

I oppose EPA's proposal to use up to 33 acres of state-owned aquatic land at the mouth of Hylebos Waterway to dispose of 700,000 cy of sediments contaminated with toxic chemicals. The site is public trust land managed by DNR. It is not a wasteland, but a biologically active and important habitat area that is used by a wide variety of birds, fish, shellfish, including 24 species of over-wintering waterfowl and 8 species of shorebirds. [3] [5] [6] [7] [8] [9] [10] [11] [13] [19] [25] [26] [91] [94] [173] [175] [176] [177]

Another concern for the Hylebos mouth site is that the DNR may not agree to allow use of this site. They probably have some very good reasons for not wanting to be party to a toxic waste dump there. There will be considerable pressure on them from outside sources to not give permission. [18] [24] [79] [93] [105] [106] [107] [108] [109] [110] [111] [112] [113] [114] [115] [116] [117] [118] [119] [120] [121] [122] [123] [124] [125] [126] [127] [128] [129] [130] [131] [132] [133] [134] [135] [136] [137] [138] [139] [140] [141] [142] [143] [144] [145] [146] [147]

I feel very strongly about the use of public lands. I believe that they are owned by the public to be preserved for the public. Aquatic public lands are especially precious because they are scarce and because they are so necessary to the survival of many species of wildlife, not the least of which is the salmon. I can not imagine why I should give up my aquatic lands so that polluters can save money. [83]

The Olympic Environmental Council strongly opposes EPA's proposal to use state-owned aquatic land at the mouth of Hylebos Waterway to dispose of 700,000 cy of sediments contaminated with toxic chemicals. We would oppose it being dumped in any other waterway, as well. [105]

Some commentors supported the Mouth of Hylebos CAD site, especially if a restoration project is included with the construction of the CAD, noting that such a restoration project would be consistent with the restoration priorities listed in the bay-wide habitat assessment (Simenstad 1999). [29] Commentors noted that the Mouth of Hylebos CAD would have the least impact on the environment of all of the three proposed in-water disposal sites. [89][150] Commetors also noted a significant cost savings could be achieved by placing all CBN/T contaminated sediments in the Mouth of Hylebos CAD site, rather than using three separate disposal sites. [89]

The Tribe is hopeful that the mouth of Hylebos site will be selected after the concerns of adjacent landowners have been resolved. We recognize that viable disposal options in Commencement Bay are extremely limited for many reasons. While the Tribe doesn't favor disposal of contaminated sediments in a CAD, we also recognize the value of compromise only if cleanup of the remaining waterways can be implemented as soon as possible. The one issue that has frustrated the Tribe is the lack of a settlement between EPA and DNR. We urge EPA to take whatever steps are necessary to put this issue to rest. The State of Washington signed the ROD in 1989 acknowledging that nearshore fills and CADs were options for remedial actions. It makes little sense to proceed with the conditions outlined on page 26 of the draft ESD, (i.e., design issues) until EPA and DNR reach agreement. [56]

Response 1: ***The significant opposition to the Mouth of the Hylebos CAD is acknowledged. During the public comment period it was discovered that the CAD site would be inconsistent with the current local Coastal Zone Management Act land use plan. Additionally, many issues raised by the landowner, DNR, about use of state-owned aquatic land have not been resolved. Therefore, EPA has withdrawn its selection of the CAD for disposal of contaminated sediments. See Response 136.***

Although EPA has withdrawn the Mouth of Hylebos disposal site, EPA still believes that the alternative is technically implementable and that short-term and long-term effectiveness issues raised during the public comment period could be addressed satisfactorily. EPA has included responses in this summary to the significant comments raised regarding the technical implementability of a CAD site at the Mouth of Hylebos Waterway to address the issues raised. Part of EPA's interest in a CAD site at the mouth of the Hylebos is because of its size and proximity to the remedial action areas and it's potential for creating salmonid habitat. While construction of a CAD site in this area would certainly facilitate the removal of the woody debris, it was not a selection factor, as suggested by one of the commentors. It is unlikely, based on experience at other locations with large accumulations of wood debris, that the problem will "resolve itself". However, cleanup of woody debris is a condition of DNR's lease, so it will be addressed regardless of EPA's designation of this site as a potential CAD.

EPA agrees that DNR, as the owner of aquatic lands, must articulate the terms under which the Mouth of Hylebos disposal site would be made available

EPA did not propose the Mouth of Hylebos disposal site so that the potentially responsible parties can save money. EPA's regulations, the National Contingency Plan (NCP), are explicit that cost, effectiveness, and implementability are required balancing factors in the decision. The mouth of Hylebos CAD was proposed because it met the ROD objectives and could have significantly enhanced critical salmonid habitat that has been identified in the Simenstad report (2000) as important to recovery of ESD-listed species. See Response 6.

EPA acknowledges the opposition to in-water disposal of contaminated sediments, on state-owned aquatic lands or elsewhere. EPA has, however, been successful at constructing in-water disposal sites at other locations.

Comment 2: Several comments expressed concern over long-term risk and hazards from a CAD. Specific concerns cited include geologic instability/uncertainty, additional risks to aquatic wildlife from the presence of contaminated sediments, loss of shellfish and beach life habitat, and drinking-well water or fish consumption from the immediate area creating exposure to toxins. [3] [5] [6] [7] [8] [9] [10] [11] [13][15] [16][17][19] [25] [26][84][86] [91] [94][96][97][98][99][100][101] [105] [173] [174] [175] [176] [177]

Response 2: *If the site was constructed, a long-term monitoring plan would be required that routinely verifies that no contaminated sediments are being released (e.g., to nearby drinking-water wells, beach habitat, etc.). Individual concerns (drinking water, seismic hazards, impacts to aquatic communities, etc) are discussed in more detail in the following sections. See Sections 2.2 and 2.3 for more detailed responses.*

2.2 Potential Impacts to People and Aquatic Organisms

2.2.1 Impacts to the Community

Comment 3: Several nearby homeowners expressed concern about whether adequate accommodations could be made during and after the construction of the CAD, including: concern over depressed property values, lack of fire protection, concern over drinking water quality, noise and other disruptions, and, limitation of water/marine access.

The proposed CAD at the mouth of the Hylebos Waterway is the only proposed site where people live and will be located 300 feet from a residential development. Privately-owned wells are the only source of drinking water for the potentially impacted residents. No studies have been made as to whether the disposal site will compromise or contaminate the domestic wells used by adjacent residents. Excavating into the aquifers increases the risk of saltwater intrusion in the water supply. Breaching the aquifer may also increase the draw-down and significantly lower the head to a point below domestic access. Will it also affect the municipal wells at-depth of the growing community on the hill above my home? What choice do the residents have if the wells become contaminated or are no longer viable? Tacoma Public Utilities does not supply municipal water in this area. We were told at a meeting several months ago that the decision to locate the disposal site here was made strictly based on engineering calculations and data, and no consideration was given to the human element. Should contamination of drinking water occur at some time in the future as a result of this siting, will the then owner or manager of the site (the DNR) be responsible for the associated costs of cleanup or lawsuits? If that were to happen, the costs would be passed on to the citizens instead of the responsible parties.

Why were the residents who live close to the proposed mouth of Hylebos CAD not involved from the very beginning, like the Puyallup Tribe of Indians? Why was Foss Tug not involved, who is a major landowner of waterfront property near the disposal site? [3] [5] [6] [7] [8] [9] [10] [11] [13][15] [16][17][19] [25] [26][84][86] [91] [94][96][97][98][99][100][101] [105] [173] [174] [175] [176] [177][181]

Response 3: *EPA believes the likelihood of impact to the drinking water wells would be very low, if the Mouth of Hylebos CAD were to be constructed. Regional ground water flow data indicate that ground water in the area most likely flows from the residents' wells towards the area of the CAD, so there is little likelihood that construction of the CAD would impact nearby drinking water wells. The municipal wells referenced are likely too far removed from the construction site to be impacted. As part of the design process, EPA would have evaluated in more detail the potential impacts of a CAD site on residents' drinking water wells for salt water* *intrusion, loss of head in the wells, and related concerns. The design analysis would have to show that these wells would not be impacted by the CAD site. If an unforeseen impact to the residential drinking water did occur from the construction of the CAD, EPA would require that an alternate water supply (e.g., bottled water as a temporary measure or hookup to municipal water as a permanent solution) be provided as part of the cost of the cleanup. To address long-term responsibility in the future, EPA would negotiate a settlement agreement requiring the potentially responsible parties (PRPs) to be responsible for the long-term maintenance of the CAD. Costs for a failure of the CAD or other unexpected impacts from it would not have been passed on to the citizens of the State of Washington through DNR.*

EPA began to discuss the possibility of a Mouth of Hylebos CAD site with the homeowners as soon as it was identified as one of the more promising potential disposal sites that would receive serious consideration. The Puyallup Tribe has been involved, as a natural resource trustee and support agency for the remedial action, since the CB/NT site was placed on the National Priorities List in 1983. Foss Tug was notified and had an opportunity to participate through EPA's public meetings associated with the Disposal Sites Forum. Although the CAD has not been selected as a disposal site, EPA will continue to work towards including interested members of the community as the cleanup is implemented.

Comment 4: Current best estimates are that construction of the CAD facility would take 3 years based on two 12- hour shifts daily, 6 days a week, assuming that the project does not encounter unseen delays. A worse case estimate that construction would run 5 years is not unrealistic, especially if the site is expanded as has been often expressed. Construction, occurring within 300 feet of our homes, will be a daily part of our community's life throughout the course of the project. Nearness of the construction activity to our homes results in a loss of privacy, loss of view, increase noise levels, and an overall loss of quality of life that we have worked to achieve within our community. Additionally, this community can expect that our limited access for parking will be pushed beyond capacity by on-site workers commuting to their job site. As a shoreline community, water craft and water based activity plays a large role in the daily lives of Marine View Drive residents. Many residents literally use their boats as many others would an automobile.

Construction activities that limit our community's easy access to open water would have an immense impact on the daily lives of our residents and severely restrict the rightful enjoyment of our properties. Bright lights will be required during periods of darkness or low light, which is of consequence to those living directly within the construction zone. Sound travels great distances over water; so increased noise levels generated by construction activities will be a consistent factor in our daily lives. If this project is rammed through, what safeguards will EPA and Hylebos Cleanup Committee (HCC) make to protect my community from suffering any adverse impacts or inherent stresses from construction and operation of the CAD facility? Will EPA or HCC provide temporary housing to those residents who may feel their homes are unlivable during the construction phase of the project?

Because CERCLA does not include a National Environmental Policy Act (NEPA) process, issues related to impacts to residents are not adequately addressed within the Superfund process. Residents, many of which are second, third or fourth generation of their family to live in these homes, will find little or no remedy for the adverse consequences of being forced to live with site construction and operation. Many homes within the community are transferred from one family member to another and this raises a number of concerns regarding long-term human health impacts if the structure should fail in any one of a number of possible ways. [16][17] [86][96]

Response 4: *EPA acknowledges that short-term impacts would have been created during construction. Because the CERCLA process includes an equivalent impacts analysis as the NEPA process, a separate NEPA review is not required. Although some short-term impacts would be unavoidable, EPA would not require or provide temporary housing during construction* *activities. Based on EPA's experience with other projects (e.g., soil removal in residential yards), the agency believes that adequate accommodations can be made without the need to relocate residents. Based on the current conceptual design, the CAD would not have prevented access to homes from small water craft entirely. Measures to minimize impacts would be addressed during the remedial design. Over the long-term, EPA believes a CAD facility could be designed that would preserve the level of services and amenities currently available to the nearby homeowners. Upon completion of the CAD, EPA believes that this site would have minimal, if any impact on existing human use and enjoyment of the area. The CAD would be under water for most tidal cycles. EPA also believes that this site would have a high potential to improve habitat conditions for fish and wildlife by increasing the area of shallow subtidal/intertidal habitats within the Commencement Bay nearshore environment.*

Comment 5: During construction, property values would plummet. At completion values would rise, but probably not to pre-construction levels. People needing to sell their homes, usually their largest asset, would find that nobody wants to live next to a waste dump and have great difficulty selling or sell at a steep discount. There is little or no reason for the residents to desire or support the Mouth of Hylebos site. This site, as well as the Thea Foss mouth site are going to impact the greatest quantities of people due to their locations. If the Mouth of Hylebos site is selected as a disposal site, it could be devastating financially to members of our community. If myself or others in my community had to sell their houses and properties it would be at a loss, if we were able to sell them at all. Is EPA or the HCC prepared to indemnify property owners against the financial devaluation of their homes?
[17] [86][22] [17] [20][22][86] [18] [24]][79] [86[93] [105] [106] [107] [108] [109] [110] [111] [112] [113] [114] [115] [116] [117] [118] [119] [120] [121] [122] [123] [124] [125] [126] [127] [128] [129] [130] [131] [132] [133] [134] [135] [136] [137] [138] [139] [140] [141] [142] [143] [144] [145] [146] [147]

Response 5: *EPA does not believe that property values would suffer long-term declines if a CAD was sited at the mouth of Hylebos Waterway because the completed project would leave no visible signs of the construction and would not be expected to significantly alter existing property uses. EPA would not indemnify property owners for construction activities necessary to ensure an environmentally protective cleanup of the Hylebos Waterway.*

2.2.2 Risks to Existing Aquatic Communities

Comment 6: Several homeowners, interested citizens groups, and individuals expressed concern over the loss of wildlife and habitat that would occur during construction of a CAD or as a result of failures of a CAD to contain contaminated sediments over the long term. Commentors described the Mouth of Hylebos area as one that has been "rejuvenated" and "transformed" over the past 10 to 20 years as a thriving habitat. [15][97][96] Commentors stated that the Mouth of Hylebos area is not a wasteland, but is a relatively healthy, existing habitat. Some of the specific points reiterated by numerous commentors are provided below.

The Mouth of Hylebos represents the last remaining unarmored and relatively undisturbed shoreline. The Mouth of Hylebos disposal site lies directly within the Hylebos Creek migration corridor for juvenile salmonids entering the bay and salmon returning to spawn and juveniles entering the bay and Puget Sound. The migration of salmonids into Commencement Bay involves thousands of small salmon whose presence in the area often extends beyond the established June 15th fish window. Later in the season the Pacific herring, a species that may be listed under the Endangered Species Act (ESA) in the future, also inhabits the area. [3] [5] [6] [7] [8] [9] [10] [11] [13][17] [19] [25] [26] [86] [91] [94] [95][173] [175] [176] [177].

There are many species that currently use the proposed Mouth of Hylebos disposal site that would be disturbed. The two to three year construction schedule will cause temporal impacts and leave all of the identified species without habitat during the construction. This, in turn, will have further negative impacts by resulting in overuse of the remaining habitat in Commencement Bay. [17]

Building this CAD is simply not worth the risk that it poses to the water in Commencement Bay and the Hylebos Waterway nor is it worth the risk to the wildlife using the area. There is no guarantee that the habitat destroyed by the proposed CAD site at the Mouth of Hylebos site will successfully be replaced. Destroying existing habitat, for the possibility of replacing it with better habitat is "ludicrous and unproven." [16][101] [84][1][73][101][174][86]

Over one hundred species of birds make this their home according to the Tahoma Audubon Society. Likewise, kelp and eel grass beds have maximized the environment of the would-be-displaced residents of the 33 acre CAD footprint; molting crabs, mussels, limpets, octopii, and crab. There is no guarantee that these beds can be reestablished nor that the existing community of organism will be restored once the project is finished, and they *will* be devastated during the excavation process. [101]

Puget Sound's aquatic resources have already been compromised too much from a variety of human activities. Please don't make this reasonable healthy area of the bay, or any other aquatic area for that matter, assume additional risk from this waste. Please do not allow the short-term economics to permit the HCC members to shirk their responsibility of properly disposing these toxic wastes in a safe location. [1]

In selecting the relatively inexpensive but as yet untested disposal site at the mouth of the Hylebos Waterway, EPA failed to employ viable, permanent and environmentally responsible options of sediment disposal using treatment technology or removal to an upland certified landfill. In making this decision, cost alone has been the single largest factor under consideration and ignores the potential cost to Commencement Bay ecosystems, the best interest of the community and possible hazards operation of such a facility could present. [86]

Response 6: *EPA agrees the intertidal and shallow subtidal areas at the mouth of the Hylebos Waterway provide habitat for numerous species of wildlife. To address concerns about salmon migration during the construction of the disposal site, EPA asked the PRPs to modify their conceptual design so that the portion of the site closest to the shoreline would be below -10 feet (mean lower low water or MLLW). Juvenile salmon feed on the aquatic organisms living in shallow areas above -10 feet MLLW. By moving the disposal site to deeper water, salmon will not be impeded in their migration at this critical life stage. As salmon grow, they move out into open water, where their movement again would not be impeded by the disposal site. In addition, a berm would be built around the entire disposal site during construction, preventing fish from entering the site and being exposed to the contaminated sediments. The material from the berm would be redistributed over the site at the end of the construction phase to form a base upon which habitat can be constructed. Also, construction will be shut down during the "fish windows", when juvenile salmon are migrating through the area.*

While the construction of a CAD facility would create short-term impacts to the aquatic habitat and associated wildlife that are dependant on the impacted area, the overall project would result in improvement in habitat beneficial to wildlife. In-water construction activities must comply with the Clean Water Act and the ESA, which require that impacts to wildlife, and especially listed species, must be minimized during construction. In addition, habitat mitigation is required to compensate for any loss of habitat. This site provides significant opportunity to construct critical salmonid habitat on top of the cap to mitigate for impacts. The February 2000 Simenstad report identifies this area as one where restoration projects would be particularly beneficial to migrating salmon.

The current use of the area where the CAD is to be located has been used for log rafting for the past 60 years. Several studies, including testing done in similar areas at the head of the Hylebos

Waterway, have shown that the accumulations of wood waste found under this type of log rafting area, often are toxic to aquatic organisms or limit their use of this habitat. Construction of a CAD with clean material as a cover, would provide a more beneficial habitat.

EPA proposed the Mouth of Hylebos disposal site in part because of the beneficial effects to salmon this site could ultimately provide. Concerns about the recent ESA listing of chinook salmon prompted EPA, DNR, and the City of Tacoma (City) to commission Charles Simenstad, a researcher at the University of Washington, to conduct a Commencement Bay-wide aquatic ecosystem assessment. The assessment, "Commencement Bay Aquatic Ecosystem Assessment" (hereinafter, the Simenstad report) has been used to ensure that enhancement of salmon habitat was an important part of our decision-making process. The Simenstad report focused on areas where salmon habitat was limited, and where habitat restoration projects would have the most benefit. The report identified four priority areas where restoration projects should be targeted, including the location of the proposed Mouth of Hylebos disposal site. The opportunity exists to design a habitat project at the mouth of the Hylebos Waterway, as was done for the St. Paul cap at the mouth of the Puyallup River, to incorporate confinement of contaminated sediments. Building new habitat beneficial to juvenile salmonids on top of the disposal site would greatly increase the acreage of habitat available in the area, so the long-term effects of the disposal site on Hylebos Creek salmon runs would be a significant improvement in habitat and forage areas.

Comment 7: [EPA] failed to require submission of an adequate biological assessment that reflects the reliance of multiple species on the proposed Mouth of Hylebos CAD site. EPA has stated that protection and/or enhancement of habitat for fish and wildlife counts highly among its goals in developing sites for sediment disposal. However, it seems that a habitat analysis of the site was not performed. This analysis is a critical screening tool necessarily performed before any site can properly be designated as a preferred site for sediment disposal. Thus, nominating the area beyond the mouth of Hylebos Waterway as a preferred site for disposal of contaminated sediments was premature. [17][86][39]

***Response** 7: EPA has chosen not to select the Mouth of Hylebos CAD in the final ESD. However, a preliminary habitat analysis had been performed and is contained in Appendix C of the Hylebos Waterway Pre-Remedial Design Evaluation Report. Had EPA selected the Mouth of Hylebos CAD, it would have been incorporated into the Biological Assessment (BA) for the CBN/T cleanup.*

2.3 CAD Feasibility and Effectiveness

2.3.1 Accidental Damage to the CAD

Comment 8: Several commentors stated that often problems arise that are not anticipated. They believe that this site by its location and its design of being underwater makes it more difficult to control and engineer than the other sites on or abutting land. One comment stated that in-water disposal is an unproven method and a great risk of sediment dispersal exists during the burial process from extreme tides and storms. Other commentors noted that, there are too many unknowns regarding the future of CAD facilities to risk developing another one in Puget Sound. [1] [16][79] [93][97] [105] [106] [107] [108] [109] [110] [111] [112] [113] [114] [115] [116] [117] [118] [119] [120] [121] [122] [123] [124] [125] [126] [127] [128] [129] [130] [131] [132] [133] [134] [135] [136] [137] [138] [139] [140] [141] [142] [143] [144] [145] [146] [147]

A few commentors stated that even with engineering controls in place, a misplaced load of contaminated sludge at the Hylebos mouth site would have the worst adverse effect of all the sites. One commentor noted that there are often problems that are not anticipated. The commentor expressed concern that the proposed CAD is underwater making it more difficult to control and engineer than the other sites that abut land. The commentor stated that while a properly sited and constructed CAD may provide some beneficial characteristics to the aquatic landscape, the risk and long term uncertainty associated with this approach outweigh the potential benefits. [28][18] [24]

I do not accept the loss of access to the waters of this state caused by the erosion and transport of dredge tailings (contaminated or otherwise) that will take place in front of their home. Are hundreds of thousands of cy of sediment plus top dressing going to be dumped underwater and not wash up on the shore? [96]

Response 8: *There is a substantial body of information on in-water disposal of materials and construction of CAD sites that has been gained through carefully reviewing efforts in the United States and in other countries. Local examples include the Simpson Tacoma Kraft cap and the Commencement Bay Puget Sound Dredged Materials Management Program (DMMP) open-water disposal site. EPA believes that this is a feasible approach and the design and construction would not be extremely difficult to accomplish.*

The CAD design includes a berm that extends to the water's surface entirely surrounding the disposal site, which would greatly minimize the potential for a load to be inadvertently dumped in the wrong place.

EPA would require that containment measures be implemented during placement of the contaminated sediments. These include a temporary berm that would enclose the site. Placement would be carefully monitored to assure that contaminated sediments do not impact the adjacent beaches or waterway. Water access to adjacent properties would be maintained to the maximum extent possible during construction activity. Future access should be unaffected. The design and construction would be monitored by EPA to assure that releases of contaminated materials would not occur; or if they occur, would be minor and addressed immediately. Also see Response 2. EPA would also require that appropriate construction and monitoring procedures be adopted and documented by the PRPs. EPA would actively monitor in-water disposal at the site to ensure proper placement and to resolve design or construction issues as they occur. EPA would require long-term monitoring of a CAD to assure project integrity and adequate protection of human health and the environment.

Comment 9: In the past there has been incidences where large freighters have been involved in mechanical failures that resulted in them floating along without power, with their large drafts the hull of these freighters could damage the cap of the CAD and release toxins to the area. This is another fact that was overlooked by EPA and should be addressed. [102]

Response 9: *The design would consider shipping accidents to the extent that it is possible to anticipate them. In the event of a potential or actual breach of the constructed CAD, EPA would require that the monitoring plan will include contingent response actions.*

Comment 10: A few commentors question what provisions would be made to restore a cap or fill that has been damaged by earth movement and /or tidal energy [12][39]

Response 10: *A long-term monitoring and contingency plan would be required for the CAD including monitoring on a planned schedule, as well as episodic monitoring after a catastrophic event that has the potential to damage the CAD. Any damage found, either during planned or episodic monitoring, would require prompt repair.*

2.3.2 Potential for Erosion

Comment 11: Without analysis or understanding of existing site conditions an arbitrary decision was made to create an up to 30 plus acre mound of contamination, based in the marine ecosystem's benthic community, and rising to within a few feet of the bay's surface and the impacts of the dynamic natural forces of current and wave. When questioned regarding the CAD site suitability for salmon habitat, Professor Charles Simenstad replied that one should instead question why it wasn't already there. The natural environment that shaped and sustained our ESA-listed salmon stocks will not, over time, tolerate an anthropogenic anomaly imposed upon it. [96]

Response 11: *In Commencement Bay, human activity and industrial development has filled in nearly all of the historic habitat (saltmarsh, mudflats, and shallow water habitats) formerly associated with the mouth of the Puyallup River. What remains of this formerly extensive deltaic complex is the steep outer faces outside the waterways of the man-made nearshore/tidefalts. Sediments deposited by the Puyallup River are funneled to this steep outer face and must settle into the deeper waters of Commencement Bay that now abut the bay, instead of spreading out the relatively shallow areas along the margins of the Bay. Given sufficient time, a new, shallow delta will form at the present mouth of the Puyallup River and the material from the river will begin to accumulate and move, spreading along the face of the present nearshore/tideflats into the Mouth of Hylebos area. Placement of material in that location, such as via a properly designed CAD site, would be merely an acceleration of a geohydrologic process that is occurring naturally already, albeit at a very slow rate. EPA's proposal in the draft ESD for a CAD at the Mouth of Hylebos was intended to take advantage of those natural processes and significantly accelerate them to develop a significant shallow water/intertidal habitat complex that would function as the nearshore/tideflats once did prior to industrial filling. This critical habitat complex would have continued to trap Puyallup River sediments, becoming larger and more varied in the long-term.*

Comment 12: Several commentors noted that the Hylebos mouth appears to have the greatest negative impact of the four finalist sites. One commentor noted that the engineering involves the use of long dikes to help control, but not stop dispersion of contaminants. The commentor believed that this is a problem because of the flow of water past this site on tidal changes and storms that would have a high potential of breaching the containment dikes. The fact that the length of the dikes is far greater at this site than any of the other site options and all the sides abut water further increases the potential negative impacts. Several commentors were concerned that the cap would not stay in place due to the amount of erosion that they experience on the shore near their homes. One commentor also expressed concern that a lot of money would have to be spent (and more construction) at a later date to replace the cap. Another problem identified in the comments is that winds can pick up the particulate from dumped dredged materials with no natural or artificial barriers to slow the winds down. Additional comments expressed that the finished elevation of the CAD facility would be only -10 feet MLLW and that tidal energy and surging wave action created by strong tides and storms would batter the outside edge of the facility. This would result in the cap of the disposal site becoming scoured out and releasing the contaminated sediments into the bay. [98] [12] [86] [14] [20] [18] [24] [4][102]

The same concerns were expressed by another commentor who indicated the north shore of Commencement Bay is an area of intense tidal energy, especially during winter storm events. These storms predominately come out of the southwest with strong winds that batter the shoreline with increased wave energy driven by winds and low air pressure. Typically, several storms of this nature occur each year. Aside from increased severe erosion of the shoreline and property damage to homes, tidal energy scours the nearshore area. After these storm events, the beach is littered with kelp, eelgrass, soft-shelled clams, and other debris scrubbed from the nearshore tidal area. Clearly the outside edge of the CAD facility, elevated from -40 to -0 feet, would similarly be battered by surging wave action and the cap of the disposal site would be scoured out. [17]

Response 12: *If the CAD had been selected, both the face of the CAD site and the cap may have been armored to protect the site from any potential damage from tidal currents and storm generated waves. Additional design studies and evaluation would have generated information including the amount and type of armoring necessary to assure project integrity. Alternatively, the outer berm and cap could have been over-designed to allow some erosion of clean cap* *material without releasing contaminated sediment. Part of the design effort would have been to properly protect the CAD while also providing habitat and insuring minimal impact to the character and use of the shoreline.*

Comment 13: [T]the log storage area that would be replaced by the CAD has acted as a breakwater for us over the years, protecting the shoreline and our houses from damage. As presented, at best, the shallow water created by the disposal site would do nothing to the wave action. At worst, it would slow the wave action down enough to cause the waves to double up and become steeper and more destructive. At the meetings I have attended the possibility of building a breakwater as part of the CAD and extending the City's water main in case of ground contamination has been discussed, but I have not heard of any serious engineering plans for this proposal. [174]

Response 13: *No engineering plans have been prepared. EPA's process does not require such plans until the site is selected and remedial design is conducted. During design EPA would determine whether a breakwater or an alternative engineered solution is a necessary component of the design, and detailed engineering plans would be developed. DNR has indicated that they may require the log storage area to be eventually removed regardless of the placement of a CAD. Therefore the log-storage area does not provide a long-term structure to protect the shoreline. In addition, Washington Department of Ecology (Ecology) is putting more and more restrictions on log storage that will also prevent their use as breakwater.*

2.3.3 Geotechnical/Seismic Stability

Comment 14: Many commentors stated that DNR data show that the site is unstable and prone to disturbances from underwater landslides.

The issues of tidal energy, geology, and seismic activity as pose a concern regarding the integral strength of the proposed facility. Failure of the disposal site would release toxins to the water column, presumably to be washed ashore with high tides. Such a failure would expose residents twice daily to passive exposure to these toxic contaminants. [17]

In addition, many commentors stated that seismic and land movement studies have not been done considering that Puget Sound is susceptible to earthquakes and earth movement. Because of this, the commentors believe that the true cost of in-water disposal cannot be estimated until the risk of land movement has been estimated and the consequences evaluated. One commentor stated that the CAD is basically fill material and liquefaction during a seismic event could likely cause facility failure. The commentor believed that regardless of the safety record for CADs in other locations, each new site with its associated geology and soils, carries it's own risks. Other commentors noted that EPA failed to require geotechnical and engineering testing to determine the suitability or safety of the site prior to designating it as a preferred disposal site. One commentor noted that the Mouth of Hylebos site is the only site in Commencement Bay where EPA did not require extensive testing to confirm a candidate site's suitability to safely construct and operate a disposal facility. Another commentor expressed concern as to whether or not the nearshore area would support the weight of the CAD facility, especially at the outside edge where the elevation drops rapidly. [17] [86][83] [101] [1] [3] [5] [6] [7] [8] [9] [10] [11] [13] [19] [25] [26] [91] [94] [173] [175] [176] [177] [99] [100] [105][86] [98][83][88] [14] [12][39][102]

Response 14: *The proposed CAD facility at the mouth of the Hylebos Waterway is only in a conceptual development stage. Because the site is not available, EPA did not select it as a disposal site. If EPA had selected the site, many aspects of the site would still need to be investigated, however. EPA had sufficient information to select the Mouth of Hylebos CAD as a disposal site. Additional information developed during remedial design would include such elements as exposure risk, sediment dispersion, tidal energy, seismic stability, geology, and the foundational stability of the site.*

EPA believes that CADs can be constructed to account for long-term risks and prevent unacceptable hazards. EPA is aware of the survey conducted by the DNR that includes the Mouth of Hylebos area as a potential seismic zone. DNR's survey is of a general nature, and shows an area of potential concern for potential landslides based on seismic activity 400 feet landward of the continental shelf, based on historical studies. The Mouth of Hylebos proposed disposal site lies within this area of concern. It does not designate the Mouth of Hylebos as being of a significantly greater risk than other areas in this broad area of concern. In EPA's discussions with DNR, they acknowledge that susceptibility to subsidence in an earthquake is site-dependent, and the purpose of the study was to highlight areas where site-specific seismic studies are needed. To prevent unacceptable hazards, EPA would require further seismic studies to modify the CAD design to account for seismic activity short of catastrophic proportions. The design studies and knowledge of other CADs are intended to construct a site that prevents the contaminated sediments from releasing chemicals above pre-defined performance standards.

2.4 Adequacy of the Proposed Cleanup

2.4.1 General Comments

Comment 15: The Wood Debris Group (WDG) notes that their spatial analysis of the data strongly indicates that the contamination is continuous, and that the appropriate approach to designating cleanup areas should presume that the sample stations located away from the HCC's designated sediment management areas indicate the presence of a continuous swath of contamination. They state that the core sample data show no indication that gaps in the contamination exist in the swath extending from the East 11th Street bridge to the entrance into the upper turning basin. The WDG further notes that with regard to stations not on the transect, the sampling is less developed along the shoals and outside the navigation channel. Nonetheless, these stations reflect significant contamination and indicate that not only is the contamination longitudinally extensive, it also encompasses most of the width of the waterway in many places. In fact, most of these stations have subsurface contamination at levels that exceed SQOs. Therefore, it should be assumed that additional cleanup is warranted beyond the designated cleanup areas. [153]

Response 15: *The comment in summary reflects the position that all areas that have contamination above SQOs at depth should be included as cleanup areas whether or not the surface sediment is clean. The designation of cleanup areas in the ESD reflect application of varying factors such as, the location in the waterway, the contaminants in question, contaminant concentrations, uses of the area, etc. See Response 22 for more detailed discussion of how cleanup areas were identified. EPA acknowledges that available sampling data indicates that the area of contamination at depth does not correlate with the area of contamination at the surface. However, it is reasonable to use different factors in determining the need for cleanup primarily because different factors are driving the risk of actual or threatened exposure to receptors and the potential for harm should such an exposure occur. Likewise, long-term monitoring of the effectiveness of the cleanup is a component of the remedial action.*

Comment 16: Occidental agrees with the ESD's conclusion that significant portions of the middle of the Hylebos Waterway require no remedial action. Furthermore, Occidental agrees with the ESD's conclusion that only three isolated, discrete Sediment Management Areas (SMA) in the middle of the Hylebos Waterway require designation for dredging, and that only four small natural recovery areas need be designated, under EPA criteria. [148]

Response 16: *Comment noted. See also response to Comment 15.*

Comment 17: Citizens for a Healthy Bay (CHB) notes that EPA has deferred a number of issues that the HCC Pre-remedial draft failed to resolve, labeling them "design issues". These so-called "design issues" include:

- Remedial actions necessary under existing structures and coordination with property owners.
- Identification of the depth of contamination relative to remedial dredging depths assuring that subsurface contamination is captured in the cleanup action.
- Determination of human health risks from releases during dredging and long-term potential for release of toxins.
- Geotechnical and engineering analysis of the proposed CAD site at the mouth of Hylebos Waterway.
- An adequate biological assessment of the proposed CAD site at the mouth of the Hylebos Waterway that accurately reflects the year-round reliance of this habitat by a wide variety of species.

CHB argues that in no other instance in Commencement Bay has EPA allowed an incomplete and/or inaccurate pre-remedial design plan to go forward, and they question EPA's decision to make an exception in this instance. In fact, HCC has already been asked on several occasions to resolve many of the issues EPA now deferred to design and has failed to do so. The commentor sees no advantage in continuing to delay HCC's compliance in resolving these and other critical issues. [39]

Response 17: *The level of information for all waterways, including Hylebos Waterway, is sufficient for the decisions made in this ESD. Additional information is needed to complete the design, but that is consistent with the CERCLA cleanup process. There is not a significantly different level of information for the Thea Foss Waterway than for the Hylebos Waterway. The HCC coordinated with property owners about uses of their properties and what the sampling data indicated about their intertidal areas. However, more specific technical studies and coordination with property owners will be required for design of a cap or dredging activity. For all these issues, EPA has sufficient information for the purposes of this ESD and will continue to develop additional information as we move through settlement negotiations and the design phase. EPA has included general performance criteria, where appropriate, for both the waterway cleanup and the disposal sites in the ESD. If at any time during design, new information is developed that indicates the cleanup will not meet the ROD objectives or performance criteria, that element of the cleanup plan will be reconsidered.*

Comment 18: Occidental incorporates in these comments by reference all positions and/or objections previously expressed by Occidental and/or the HCC regarding pertinent issues. Such positions and/or objections include, but are not limited to: (a) the purported "expansion" of the two Hylebos "problem areas" established by the ROD; (b) the inappropriate use of benthic testing and analyses; (c) the development and application of inappropriate cleanup criteria, including but not limited to sediment quality objectives, remedial action levels, natural recovery requirements, and altered approaches to subsurface sediment; (d) reliance upon inappropriate testing, analyses, data, and data interpretation methodologies; (e) failure to consider, and/or inadequate consideration of, the cost/benefit consequences of particular actions or requirements; (f) the application of approaches inconsistent with EPA policies and guidance; and (g) actions and requirements by EPA that have resulted in exorbitant and/or inappropriate oversight and response costs. Occidental also reserves the right to adopt positions or objections asserted by other parties. [148]

Response 18: *The form of the comment contains insufficient information to base a response in this summary. However, it is acknowledged that positions and objections have been raised by the commentor and other members of the HCC throughout the development of the pre-remedial design studies, and have been responded to by EPA in reports and/or correspondence, which are contained in the administrative record for this ESD.*

Comment 19: The Washington Department of Fish and Wildlife (WDFW) continues to have concerns regarding the potential impacts on water circulation and dissolved oxygen (DO) levels within the Hylebos Waterway resulting from the proposed dredging depths. As we indicated in our August 18, 1999 comment letter on the Pre-Remedial Design Evaluation Report for the Hylebos Waterway, there are currently problems with depressed oxygen levels during the late summer and early fall in the waterway. Also, current WDFW regulations (WAC 220-110-320(7)) require that dredging depths in channels not exceed channel depth at the seaward end to avoid such problems. While provision is made for some adjustment of this standard in authorized berthing areas and turning basins, these modifications require some justification. Areas with existing DO problems are inappropriate candidates for such a variance. WDFW recommends that modeling efforts be conducted to evaluate the potential impacts of the proposed dredge depths on circulation and DO in the waterway. They further recommend that long term monitoring of these parameters be conducted to verify the modeling results and ensure satisfactory water quality subsequent to the remedial action. [28]

Response 19: *EPA is aware of the current DO situation in the Hylebos and will not accept any final dredging plan that would result in further degradation of the existing DO conditions. EPA is also aware that the current conceptual dredge plan for Hylebos shows many changes in bottom elevation that have the potential to create isolated low DO pockets. EPA will require that the PRPs redesign the dredge cuts to "smooth out" these areas in design, or do the necessary modeling to show that the proposed uneven bottom will not impact water quality in the long-term. In addition, water quality will be closely monitoring during the entire construction process and after completion to assure adherence to state water quality standards. At the very least, EPA will require the selected remedy to maintain current water quality conditions.*

2.4.2 Subsurface Contamination

Comment 20: The Partnership for a Clean Waterway (PCW) believes that the approach used by EPA to designate areas for cleanup, based on subsurface conditions, is a fundamental departure from the performance criteria set forth in the ROD. The ROD Sediment Quality Objectives (SQOs) apply only to surface sediment, since the point of compliance is the biologically active zone—the top 2 to 10 centimeters of sediment. The ROD recognized that if surface sediment is clean (meets the SQOs) it does not represent an unacceptable threat to human health or the environment. Applying SQOs to subsurface sediments is a change in performance criteria and requires a ROD amendment. [150]

Response 20: *The approach used by EPA to designate cleanup areas is not a fundamental departure from the performance criteria in the ROD. The 1989 ROD sets forth cleanup levels that are to be met in the biologically active zone <u>in the long-term</u>. The ROD incorporates the concept that physical disturbance is a factor in determining where remediation is required. Thus, for the cleanup to be effective in the long-term, pre-design studies had to show, with a high level of certainty, that contaminated subsurface sediment had no potential to become exposed and recontaminate surface sediments. However, pre-design studies did not show that post-cleanup recontamination of clean surface sediments by contaminated subsurface sediments would not occur, so several areas with subsurface contamination were added to the cleanup plan (See Response 22). These stations were added in order to meet the ROD objectives, and no ROD amendment is needed. See also Response 40.*

Comment 21: The PCW further believes that the ESD requirement for dredging subsurface sediment instead of allowing for natural recovery is in direct conflict with the 1989 ROD. The ROD recognized that surface sediment that is predicted to recover to the SQOs within ten years does not present an unacceptable threat to human health and the environment. The ROD concluded that where surface sediment is clean or predicted to recover naturally within ten years, further action is not warranted under the federal Superfund program. EPA's 1989 Responsiveness Summary states: "natural accumulation of cleaner sediment that would result in recovery over a reasonable time period was preferred to the potential adverse impacts of sediment confinement operations (e.g., burial of existing benthic communities). Natural recovery increases the feasibility of sediment remedial action by enabling resources to be focused on more highly contaminated areas, and by reducing overall costs." The EPA's proposed use of subsurface data is a fundamental altering of the scope and performance criteria set forth in the ROD. It requires a ROD amendment before it can be applied to design and construction of the remediation. [150]

Response 21: *The use of subsurface data to make remedial action decisions is not a fundamental alteration of the scope and performance criteria set forth in the ROD, and a ROD amendment is not necessary. See Response 40. The 1989 ROD includes natural recovery as a component of the remedy in areas that are expected to meet SQOs within 10 years of sediment remedial action. It also notes that recovery factors will be modified based on source loading and sediment data collected during remedial design. The ESD cleanup plans for both Hylebos and Thea Foss/Wheeler-Osgood waterways include a natural recovery component, consistent with the ROD. Part of the remedial design analysis for natural recovery included evaluation of subsurface contamination and its potential to impede the long-term success of natural recovery through future recontamination. The ROD states (p 59) that the "relatively low impact of potential exposure to underlying sediments in marginally contaminated areas" is one of the factors that makes natural recovery an acceptable alternative to active remediation. This analysis was included in the determination of whether SQOs could be met within 10 years. This is fully consistent with the 1989 ROD approach of only allowing natural recovery in areas where further analysis during design shows SQOs will be met in 10 years.*

Comment 22: In the draft ESD, areas with clean surface sediment and areas predicted to recover naturally are slated by EPA for cleanup based on speculation that subsurface sediment might someday be disturbed. PCW comments that actual data conclusively demonstrates that there is low probability of subsurface sediment disturbance at the subject locations—evidenced by the clean surface sediment currently at those locations. If subsurface sediment at the subject locations was a problem, it would have already caused degraded surface sediment quality. [150]

Response 22: *EPA disagrees that existing surface sediment contamination can be used to draw conclusions about the probability and effects of disturbance. The HCC was offered the opportunity to provide evidence in the form of a scour analysis to show these areas will remain as is. The resulting analysis was fairly qualitative and had a high degree of uncertainty. In response, EPA completed its own evaluation of the waterway data to determine the possibility of subsurface disturbance. Individual stations with shallow subsurface chemical concentrations in excess of the segment natural recovery factor that were located in or adjacent to the navigational channel or in areas of higher ship activity (holding or docking areas, turning areas, marina entrances, etc.) were included in nearby cleanup areas. Stations with similar characteristics adjacent to dredging areas were also identified for active cleanup. EPA has included these additional areas in the cleanup plan to reduce the likelihood of post-remedial action recontamination and the need for additional cleanup with its associated expense, monetary and environmental. This approach addresses contaminated subsurface sediments with a high to moderate potential for exposure in the future. Contaminated subsurface sediments with a low potential for exposure would remain in place, subject to long-term monitoring.*

Comment 23: The U.S. Fish and Wildlife Service (USFWS) and the Tribe asked that when possible and/or when subsurface contamination will be exposed, that EPA require removal of these sediments from the waterways and not rely on institutional controls. These sediments, if left in place, may adversely impact natural resources or become the reservoir for recontamination. All subsurface contamination within the active channel should be removed as part of the sediment remedy. [29] [56]

Response 23: *The cleanup plans in the ESD reflect consideration of the potential disturbance of deeper subsurface contamination in the designation of dredging and capping areas, and in determining the depth of dredging areas. The cleanup of the Hylebos Waterway addresses extensive areas of subsurface contamination. The ESD addresses all area where EPA believes* *there is a reasonable potential for subsurface contamination to become exposed through natural or anthropogenic erosional forces. However, the cleanup does not address all subsurface contamination.*

Comment 24: NOAA supported the concept of dredging to native sediments as a means of removing all contamination, with the caveat that the final exposed surfaces be sampled to confirm that target chemicals of concern are below the SQOs. [81]

Response 24: *EPA will require sampling to confirm SQOs are met on exposed surfaces after dredging.*

Comment 25: The WDG believes that the HCC did not perform an adequate analysis of the mechanisms that can disrupt sediments and lead to recontamination and hence the ESD does not adequately take this into consideration in developing the cleanup plan. While the draft ESD provides that contaminated sediments may remain in place if the potential for exposure is low, it fails to indicate what criteria should apply in determining the propensity of sediment areas for exposure. Absent a demonstration that contaminated subsurface areas cannot be disrupted, the WDG requests that the ESD designate all parts of the waterway with significant subsurface contamination as cleanup areas, to eliminate the potential for recontamination of the Hylebos Waterway. The WDG is concerned that the HCC has tried to downplay the significance of the potential for recontamination by comparing changes in bottom contours and relying on a self-developed physical disturbance index (PDI) that was discredited in EPA's technical review. Rather than confront the issue of the probability of future disturbances, the HCC made a perfunctory assessment by looking back in time and discussing only the subsurface contamination that has not yet been exposed. Not only does this restricted approach fail to address sediment behavior in the future, it ignores any assessment of whether surface sediments that currently exceed SQOs were derived from prior subsurface contamination. [153]

Response 25: *The Hylebos Waterway cleanup has been expanded beyond that originally proposed by the PRPs to address the potential for recontamination of clean surface sediments by contaminated subsurface sediments. The criteria EPA used for including stations with subsurface contamination in the cleanup plan are discussed in Response 22.*

This approach addresses contaminated subsurface sediments with a high to moderate potential for exposure in the future. Contaminated subsurface sediments with a low potential for exposure would remain in place. Long-term monitoring would alert EPA if some if these areas did become exposed in the future, and PRPs would be responsible for addressing any recontamination. EPA is not, however, considering future navigation dredging as one of the factors in our analysis because existing regulatory programs must consider potential for exposure of contaminated sediment and require that such sediment be handled appropriately.

Comment 26: The WDG commented that any phenomenon that can penetrate the thin surface sediment layer has the potential to redistribute subsurface contamination into the surface layer. The universe of means by which surface sediments can be disrupted cannot be predicted. However, likely causes of such disruptions include ship scour, tidal scour, vessel grounding, removal of structures, installation of structures, and maintenance dredging. Once the surface layers are disrupted, heavily contaminated sediments become exposed. Although the exact mechanisms of recontamination are not known with certainty, observations and investigations within the Hylebos Waterway indicate that recontamination is occurring. For example, the EPA contractors that performed the remedial investigation for Commencement Bay determined that ship scour and releases from adjacent dredging operations had exposed and transported contamination from subsurface sediments to the surface layer. Maintenance dredging in the lower turning basin has been determined to have spread polychlorinated biphenyl (PCB) contamination. [153]

Response 26: *See Response 25.*

Comment 27: The WDG provided specific technical examples of processes that might disturb surface sediments, including:

- Installation or removal of pilings and other structural components,
- Ship scour, including scouring caused by propeller wash, surge, and suction effects caused by inadequate under keel clearances, and
- Near bottom tidal currents, which are sufficiently strong to approach scour velocities in the middle and mouth sections of the Hylebos Waterway. [153]

Response 27: *EPA agrees that it will be important for private property owners and regulatory agencies to be aware of the potential for subsurface contamination to become exposed during future construction activities. Institutional controls to reduce the potential for future exposure of subsurface contaminated sediments have been included in the ESD. Institutional control mechanisms that may be applied to natural recovery areas or where capping is used are: existing regulatory programs that oversee in-water work on pilings installation and removal, dredging, and shoreline development and property land use restrictions.*

EPA also acknowledges the potential for resuspension of sediment due to ship scour and erosion from currents. The cleanup has been expanded to include any significant areas of subsurface contamination within or near the navigation channel in the cleanup plan. See Response 22 and Response 25.

Comment 28: WDG notes that the HCC seeks to justify leaving heavily contaminated subsurface sediments in place by asserting that recontamination is not likely because locations are either distant from currently designated areas, outside the formal navigation channel, away from docks, or have been subject to a favorable DMMP determination. By taking this approach, the HCC has avoided having to define the areal extent of subsurface contamination and thus shifted the discussion of contaminated areas to a station-by-station focus. This approach has allowed the HCC to exclude areas with heavy subsurface contamination from incorporation into sediment management areas. For example, the HCC has designated station 4102A for "no action" on the representation that it passed DMMP bioassay interpretive guidelines. However, Station 4102A, which is located near the center of the waterway, exceeds DMMP Maximum Levels (MLs) for at least nine chemicals (2-methylnaphthalene, acenaphthene, anthracene, fluorene, phenanthrene, benzo(a)anthracene, benzo(a)pyrene, benzo(b+k)fluoranthenes, pyrene, and total low molecular weight polycyclic aromatic hydrocarbons (LPAHs) and is not eligible for disposal at a DMMP site. [153]

Response 28: *DMMP ML exceedances in light of the bioassay results may still receive a suitability determination from DMMP agencies according to a clarification provided by the Corps of Engineers (Corps) (S. Sterling, pers. com. 4/11/00). However, these data are not being used for a suitability determination, rather the DMMP bioassay results were used to screen for the potential for recontamination. In this case, the bioassay results were used by EPA as an indicator of what a biological response may be if these same subsurface sediments were exposed. Given the fact the bioassays passed, EPA did not feel that 4102A warranted active cleanup.*

Comment 29: WDG comments that to implement an effective and permanent remedy, EPA needs to acknowledge that the Hylebos Waterway is an engineered watercourse that is subject to various forms of navigational and construction activities. These activities, in combination with the net circulation pattern, indicate that the potential to redistribute chemical contamination throughout the waterway is significant. The various investigations of the Hylebos Waterway show that contaminants such as polycyclic aromatic hydrocarbons (PAHs) and PCBs are widely distributed throughout most of the Waterway's surface and sub- surface sediments. For example, PCBs are distributed at concentrations consistently above 300 μg/kg in the area that begins outside the Upper Turning Basin and extends all the way to the Eleventh Street bridge. In many cases, the concentrations of PCBs appear to increase strongly at a depth of 10 to 20 centimeters. [153]

Nordlund Boat also notes that there is compelling evidence that the PCBs have migrated from the neck area into the head of the waterway and were distributed to the sides of the upper turning basin by the disturbances to sediment caused by the turning of large ocean-going vessels. As long-time observers of activities in the Hylebos, they have personally witnessed the upper turning basin turn brown from the suspension of sediment caused by the large tugboats that turn the ships.[178]

Response 29: *EPA agrees that there are various factors that could redistribute chemical contamination in the waterway. EPA has considered this issue in designating cleanup areas. See other responses in Section 2.4.3.*

2.4.3 Limitations/Restrictions on Future Use

Comment 30: The Port of Tacoma (Port) commented that they agree with EPA's statement that "Exposure of contaminated subsurface sediments may occur during the cleanup by dredging adjacent areas, through physical processes, such as storms or ship scour, or through future dredging or excavation". However, the Port does not agree that EPA appropriately applied the criteria in selecting the cleanup plan provided in the ESD. EPA has continued to propose natural recovery and no action in areas where exposure of contaminated sediments will occur in the near future, despite several comment letters from the Port identifying areas where this would be incompatible with Port activities. Specific areas of concern include sediments in front of Parcel 4, the former Murray Pacific site, the former Wasser Winters site, and within the channel north of East 11th Street Bridge. Because of this, the estimate of 940,000 cy of contaminated sediment is inaccurate. Sediment volumes in these areas should be added to the 940,000 cy estimate in order to obtain an accurate estimate of the total cleanup volume. These areas will need to be included in the Hylebos Waterway clean up regardless of whether the Corps performs an additional, extensive dredging project. [154]

The WDG commented that removal of all significant contamination from the active stretches of the Hylebos Waterway is important if recontamination in the coming decades is to be avoided, and that the proposed cleanup for the Hylebos Waterway as depicted in the draft ESD is deficient because it allows substantial subsurface contamination to remain as a reservoir for future recontamination. One of the characteristics of industrial waterways is the propensity for unpredictable change as economic considerations change over time. As economic and land uses evolve, users of waterways must undertake various projects such as maintenance dredging and waterway development that will disrupt sediments. Although capping and natural recovery may be suitable for areas where sediment profiles are expected to be stable, they are inappropriate for the relatively shallow Hylebos Waterway which is an active port where sediments are periodically disturbed by the activities that are inherent to ports. The WDG believes that the approach of shifting the burden for determining future uses to property owners is unfair. The unspoken premise that property owners can know about future uses is unreasonable. For example, The WDG and the Tribe note that today, the Hylebos is a key element of the Port's future development plans. Four years ago, the Port had little interest in the Hylebos Waterway. Subsurface contamination within the active areas of the waterway that is proposed to be left in place will present many difficulties for future property owners as well as potentially jeopardize the remedial efforts. [153][56]

Response 30: *Based on the information developed in these discussions and application of the CERCLA remedy selection criteria, EPA has focused on minimizing the potential for future exposure of contaminated sediments, including the potential for exposure of subsurface* *contamination. EPA considered the following guidelines with regard to accommodating future land use in developing the cleanup plan:*

- *All areas where surface contamination is not predicted to naturally recover to SQOs in 10 years, or where there is a reasonable chance that subsurface contamination may recontaminate surface sediments through ship scour, storm surge, or other natural or anthropogenic forces, are included in the cleanup plan.*

- *Where active remediation is needed, dredging to a clean sediment surface is required.*

- *In areas where EPA has not required cleanup under the criteria cited above, but the Port or property owners want cleanup to occur for future development purposes, EPA will make every effort to work with these parties to coordinate additional cleanup to occur at the same time as the overall waterway cleanup.*

- *EPA will actively work with the Corps of Engineers to allow the Corps to perform any needed maintenance dredging at the same time as the waterway cleanup, but it is not a requirement of the Superfund cleanup.*

- *PRPs will remain liable for subsurface contamination that becomes exposed in the future. Compliance with existing laws and, where necessary, Superfund institutional controls will be used to minimize exposure to contaminated subsurface sediments. Post-cleanup monitoring will be required to ensure the remediation remains protective and sediment recontamination is detected.*

EPA has determined that it is not necessary to remediate all contaminated sediments in Commencement Bay to ensure protection of human health and the environment. EPA will, however, work with the Port and property owners to include additional dredge volumes as necessary to accommodate future uses. Property owners requesting additional dredging may be required to pay the incremental cost increase for the work.

Comment 31: The WDG comments that although the Hylebos Waterway is an active area of an industrial port, the draft ESD provides relatively little discussion of how EPA will accommodate routine waterway activities following the cleanup. The intent expressed in the draft ESD appears to be that the HCC or successors will be excused from the requirement to remove subsurface contamination during the CERCLA cleanup on the grounds that regulatory requirements associated with dredging will ensure that proper disposal of contaminated sediments occurs. What is not discussed is that it will be much more difficult after the cleanup to find feasible disposal sites and the effect that the lack of disposal options will have on the environmental condition of the waterway. The Tribe recommends removal of subsurface contamination within the active channel, which will allow for expedited maintenance dredging in the future without the need for expensive, time consuming regulatory processes and most importantly the need for more disposal sites in Commencement Bay. [56][153]

The WDG also notes that the ESD does not explain the magnitude of the regulatory burdens associated with waterway projects that involve contaminated sediments. For example, the permitting efforts for projects involving contaminated sediments are more extensive, time-consuming, and expensive. Likewise, biological assessments involving toxic constituents are more expensive to prepare and take longer to review. Therefore, EPA should explicitly tell parties that removal of all the contaminated subsurface sediments will expedite waterway use and development by reducing the regulatory effort required to approve future projects. [153]

Response 31: *Selecting disposal sites for the cleanup was difficult, and it is not likely to be easier for future routine dredging. EPA is actively working with the Corps to include any* *needed maintenance dredging with the CERCLA cleanup. EPA has also encouraged property owners in the ESD, and will continue to encourage them during CD negotiations, to identify any dredging needed for future development activities, and to conduct such dredging as part of the cleanup.*

Comment 32: The WDG comments that the draft ESD appears to accept a cleanup approach which shifts responsibility for removing subsurface contamination from the parties responsible for the contamination to other parties who will continue to use the Hylebos Waterway for maritime activities. Furthermore, while the draft ESD does not explicitly state that EPA intends to limit future activities, there are indications that it implicitly intends to do so. EPA has proposed in the draft ESD to extend institutional controls to affirmative restrictions on the use of real property in and along the waterway. The draft ESD also proposes to use city ordinances and deed restrictions (presumably imposed unilaterally under CERCLA § 106) as a means of limiting use of the waterway to reduce the prospect of exposing subsurface contamination. This approach is fundamentally wrong because institutional controls are unlikely to prevent exposure of subsurface contamination and such controls allow the responsible parties to incur a financial benefit at the expense of future users of the waterway. The Port believes that taking this approach is unwise and will prove to be an undue burden on regulatory agencies such as the Ecology, Corps, USFWS, WDFW, National Marine Fisheries Service (NMFS), and the City, because those agencies will be left with having to find ways to address contaminated sediments that should have been addressed in the Superfund process. This approach will also put the burden of finding and paying for a confined disposal site on the landowners and not on the polluters, or lead to future lawsuits between landowners and responsible parties. [154][153]

Similarly, Nordlund Boat opposes a cleanup approach for the Hylebos Waterway that leaves in place contaminated sediments at depth at concentrations that exceed the SQOs. They support the removal of contaminated sediments in the Hylebos Waterway wherever they exceed the SQOs and regardless of whether the contaminated subsurface sediments are covered by clean surface sediments. Nordlund Boat is particularly concerned about subsurface PCB-contaminated sediments that the ESD proposes to leave in place off shore of Nordlund's dock. In effect, Nordlund Boat is being held responsible for the cleanup of PCB contaminated sediment, even though there is no evidence that activities on the Nordlund Boat property contributed to the presence of PCBs. Nordlund Boat is concerned that any future in-water improvements e.g., berth deepening, replacement or extension of the dock, could be more difficult to permit and more expensive to conduct because of the presence of the PCBs.

Nordlund Boat notes that they were hoping that the benefits arising from the consent decree, such as certainty, finality, and the removal of the stigma associated with unresolved Superfund liability, might come close to matching the significant costs and uncertainties that they have endured over the last decade or more. Unfortunately, the ESD seems to promise that Hylebos waterfront property owners will continue to face significant uncertainties because of EPA's decision to allow the HCC to leave in place contaminated sediments at depth at concentrations that exceed the SQOs. [178]

Response 32: *EPA's mandate under CERCLA is to protect human health and the environment. The ESD cleanup plan does this through a combination of removal (dredging), engineering controls, and monitoring. As noted in Response 30, EPA will work with property owners to add any additional cleanup (dredging) to the cleanup plan for future development purposes at their discretion. EPA's land use policy requires that we consider a reasonably anticipated future use in our risk assessments. However, contamination may be left in place if it is otherwise a protective remedy. Nordlund's comment specifically refers to station 1113, which contained PCBs in subsurface sediment at 1.04 times the SQO, only slightly above the cleanup level. EPA does not believe that this marginally contaminated area, if exposed, would represent a human health or ecological threat. Property owners are welcome to include any additional dredging they think they need for future development plans, and are encouraged to do so if they are* *willing to pay the additional cost. If they don't do this, they will be responsible for making sure that the contaminated materials are handled in an environmentally responsible fashion when they do make future development plans. See Response 30.*

Comment 33: PCW commented that adding new ESD performance criteria or site use restrictions is a contradiction to findings of the ROD. They note that EPA stated in the 1989 ROD Responsiveness Summary that permitting requirements under the Clean Water Act and the State Shoreline Management Act are in place for any dredging or other development activity that may involve excavating sediments to accommodate a new future use. Those permitting requirements do assure that sediment will be handled in an environmentally responsible fashion, and that newly exposed sediment does not pose an environmental concern. [150]

Response 33: *The ESD more clearly designates the institutional control objectives that are required for confined sediment to ensure the remedy is protective of human health and the environment. It also provides the types of institutional control mechanism that will be relied on or, in some instances, implemented if feasible to achieve those objectives. Such added details on institutional controls provided for in the ROD are no more than significant differences, which is why they are included in this ESD.*

Comment 34: The Port viewed institutional controls on land use along the Hylebos Waterway as excessive and felt that "[e]xisting federal, state, and local regulations and permit requirements are more than adequate to safeguard the environment from activities associated with future use." The Port made the case that institutional controls represents a penalty to non-polluting landowners that would escalate the cost of doing business in the tideflats and be viewed a detriment to future businesses or developers. The Port further stated that "[a]s a major landowner in and along the Hylebos, [it] can not accept controls that would encumber the continuation of existing uses or limit future uses of its property. We request that this change be deleted from the ESD." [154]

Response 34: *Land use restrictions would have limited use as part of the remedy and would be applicable only in those areas where natural recovery, or capping are used as the remedy. Any area designated as a disposal site would also be subject to some institutional controls. It is anticipated that such restrictions would only be used where it is necessary to preserve the long-term effectiveness of a remedy for a specific area. As an example, no future dredging would be allowed at a CAD site. Some restrictions on the depth of dredging may be included in areas where a cap is constructed so that confinement of underlying contaminated sediment is maintained over time. EPA expects that such protective measures can be addressed through existing regulatory land use regulations and permits. Separate agreements may be required where existing regulations may not be sufficient to ensure the remedy remains protective. However, if land use restrictions are put into place, such reserved uses will only be applicable if the contamination stays in place. Nothing about a land use restriction will prohibit a landowner from removing the contamination such that all restrictions could be eliminated.*

2.4.4 Efforts to Inform Property Owners

Comment 35: The Port and WDG note that the HCC's 1995 [sic] property owners survey of future uses was inadequate. They request that EPA revisit the issue of future uses with property owners along Hylebos Waterway, to get a more accurate picture of future use. The Port states that EPA's view of future use does not include likely long-term uses. EPA should perform it's own survey that provides owners with full disclosure of how leaving contaminated sediment on their land will effect current uses, future development, and property values. EPA should also identify and notify impacted parties of the additional costs that would be borne by landowners and by federal, state, and local permitting agencies to address contaminated sediment that EPA had left behind. EPA should identify how and when those landowners and permitting agencies will be able to recover costs from the polluters who caused the contamination that impacted their current and future development and use. The WDG notes that the HCC's survey of future uses asked property owners to provide information only for those projects currently underway or for which the owner intended to submit permit applications prior to June 1999. The HCC did not ask property owners to provide information regarding the projects that might occur after 1999 or to describe navigation needs that will require maintenance dredging in the channel and adjacent areas. The draft ESD is founded on a view of future use that is very short-sighted.[154] [153]

The WDG comments that the HCC's inadequate effort to inform property owners and the public about the extent of subsurface contamination has resulted a proposed cleanup that will leave substantial areas of the waterway unaddressed. Although the draft ESD invites current property owners to include additional dredge areas if future plans could expose contaminated sediments, no mechanism has been provided to ensure that property owners have actually been informed that sediments on or near their properties are contaminated at depth. Furthermore, the draft ESD does not make it clear that property owners can add contaminated sediments to the cleanup at no charge to themselves provided they are not responsible for contaminating the sediments. Based on the draft ESD, it appears that no party who is not a member of the HCC has requested an expansion of the cleanup as a result of the HCC's alleged communication efforts. [153]

Response 35: *Aside from property owners survey in 1994, EPA has held periodic meetings for Hylebos property owners to apprize them of the status of the cleanup plan and implications for their property. Property owners have had ample opportunity to review the cleanup plan and ask EPA questions. As indicated in response to comments 30 & 32, property owners will have additional opportunity to incorporate development dredging into the CERCLA remedial design.*

Comment 36: The WDG states that EPA has not explained the legal implications associated with leaving contamination in place. For instance, legal protections granted to settling parties may preclude cost recovery against them by parties forced to remove and dispose of contamination at a later time. Similarly, property owners can be held liable if their activities inadvertently expose the contamination that EPA has allowed to remain behind. In this respect, the draft ESD does innocent property owners a disservice by implying that they have an opportunity to address contamination in areas that may affect their future activities yet failing to disclose where these areas are located. [153]

Response 36: *See Response 30.*

2.4.5 WRDA/Corps Dredging

Comment 37: Ecology noted their appreciation for the excellent work EPA has done communicating with the Corps and other agencies regarding the Water Resources Development Act (WRDA) sponsored navigation dredging of Hylebos Waterway. Ecology encouraged EPA to continue with this effort and noted their commitment to helping in any way to accomplish the more complete remedy that would be realized through a combined navigation and remedial dredging. If the combined navigation and remedial dredging does not occur, the current shoaling hazards to navigation would remain, navigation dredging would continue to be hindered by contamination at depth and; we face the prospect of piece-meal cleanups where future dredging projects need to address contamination at depth (or contamination waiting for natural recovery). For these reasons, the remedy must include the navigation dredging areas affected by contamination (at the surface or at depth) whether or not the WRDA funding becomes available. This will be an important part of Ecology's determination to continue support of the ESD. [80]

Ecology also commented that changes in channel geometry due to navigational dredging and/or new uses of property may affect EPA's expectations concerning natural recovery or stability of existing caps. This needs to be reviewed as EPA makes progress on WRDA sponsored navigation dredging. [80]

PCW further commented that WRDA environmental dredging could address the subsurface sediment issues raised by EPA without any changes to the existing ROD. [150]

Response 37: *The 1989 ROD Responsiveness Summary clarified that CERCLA actions were not intended to address navigational dredging. EPA is fully supportive of a navigational dredging project and will continue to coordinate with the Corps and private parties to encourage efforts to combine navigational dredging needs with the Superfund cleanup, if it can be done without delaying the Superfund cleanup.*

If a combined project is not done, EPA will work with Corps to ensure that any caps do not interfere with, or would not be compromised by, future navigation dredging. As far as new uses of the property, see Responses 30 - 35.

Comment 38: The WDG noted that although maintenance dredging was conducted at frequent intervals prior to the listing of Commencement Bay on the National Priorities List (NPL) in 1981, only a few small and localized private maintenance dredging projects have been conducted in the Hylebos Waterway since that time. The Corps has stated that maintenance dredging in the Hylebos Waterway is being deferred based on an understanding that EPA-lead CERCLA activities would result in the removal of contaminated sediments in areas that will be affected by maintenance dredging. Maintenance dredging can be expected to affect the navigation channel and adjacent areas. In addition to channel maintenance conducted by the Corps, private parties need to dredge the portions of the waterway in the vicinity of their properties to maintain navigation access. Dredging projects not only incur the risk of exposing contaminated sediments, they will generate contaminated dredged material that will need special disposal. [153]

PCW commented that EPA states in the Responsiveness Summary to the 1989 ROD that CERCLA actions do not cover maintenance dredging and areas that may require maintenance dredging or navigational dredging actions will be addressed outside of CERCLA by the substantive and procedural requirements of existing regulations such as the Clean Water Act Sections 401 and 404, hydraulics permits, shoreline substantial development permits, and DMMP. [150]

Response 38: *The cleanup plans contained in this ESD comply with the requirements of the ROD and the 1997 ESD. The ROD anticipated that the CERCLA cleanup would not address areas solely because they may require maintenance dredging in the future. If future dredging projects encounter contaminated sediments, they will have to be disposed of in accordance with DMMP and other applicable laws and guidelines.*

Comment 39: MWAC believes that finalizing the ESD will negatively impact ongoing efforts to explore the viability of proceeding with a dredging project in the Hylebos Waterway under Section 312 of WRDA. A WRDA action for the Hylebos Waterway offers numerous environmental and navigational benefits, including the potential for conducting a larger dredging effort and more comprehensive cleanup, restoring full commercial navigational draft in the waterway, and enhancing economic development in the waterway. [57]

Response 39: *EPA does not believe that delaying the ESD or making final decisions on how the Hylebos Waterway should be cleaned up would be good for the environment or the community. Likewise, EPA does not think making a final decision necessarily will adversely affect ongoing discussions about a potential WRDA project. EPA has had numerous discussions with the Corps regarding the potential for a WRDA dredging project in the Hylebos Waterway, and both EPA and the Corps agree that finalizing the ESD will have no impact on the Corps' ability to do a WRDA project. The Corps' ability to do a WRDA project is more dependent on the availability and willingness of a local sponsor, the availability of funding, and timing issues, than it is on the ESD.*

2.5 Fundamental versus Significant Changes to the ROD

Comment 40: The ESD reflects fundamental alterations to the CBN/T ROD with respect to the scope, performance and cost of the remedy. Thus, CERCLA and the NCP require a ROD amendment(s) rather than an explanation of significant differences. 40 CFR Section 300.435. [148][150]

(a) Comments on fundamental alterations of scope of the remedy:

The ESD and the Hylebos EPA Cleanup Plan inappropriately, and without justification, depart from the ROD's "problem area" determination and conclusion that remediation should be conducted separately in each "problem area." The ROD should not be so fundamentally altered. Indeed, the ESD and the EPA Cleanup Plan themselves demonstrate the appropriateness of the ROD's conclusion that the Hylebos should be addressed in separate "problem areas." [148]

The differences in the ESD's draft cleanup plan fundamentally alter the selected remedy for Hylebos Waterway with respect to scope because of the elimination of the Problem Area limits in the ROD; addition of habitat function and enhancement of fisheries resources as a cleanup goal; and addition of subsurface sediment.[150]

(b) Comments on fundamental alterations of performance of the remedy:

The differences in the ESD's draft cleanup plan fundamentally alter the selected remedy for Hylebos Waterway with respect to performance because there is: near elimination of natural recovery from the remedy; and application of surface sediment SQOs to subsurface sediment.[150]

The ESD accurately observes that "[t]he ROD recognized that the estimated volume of sediments needing active remediation would be refined during remedial design phase and that both volume and costs 'are anticipated to change accordingly.'" ESD, p. 5 (quoting the ROD, emphasis provided). The expansion of the Hylebos sediment volume from the ROD's estimate of 448,000 cy to the ESD's estimate of 940,000 cy (or perhaps even an estimated total 1.3 million cy) cannot be characterized as a "refinement." The ESD's more than doubling (or perhaps trebling) of the sediment volume reflects drastic and inappropriate departures from the ROD through the application of various criteria and EPA decisions to which the HCC has previously objected. [148]

The volume for Hylebos Waterway should be corrected to include the 175,000 cy of wood-waste related dredging mandated by EPA and currently proposed by the WDG. EPA's "refined estimate" of 1,115,000 cy (including wood waste related cleanup) is at least 667,000 cy greater than the ROD volume of 448,000 cy for Hylebos Waterway. The draft ESD represents a volume that is 2.5 times larger than the ROD. As such, the draft ESD does not represent a "refined estimate" of the ROD volumes, but rather a fundamental change in the scope of the cleanup, based on near elimination of natural recovery from the remedy, as well as addition of subsurface sediment in areas that fully satisfy ROD cleanup requirements. These fundamental changes cannot be addressed by an ESD, but rather require a ROD amendment and evaluation of the nine CERCLA criteria in order to comply with the NCP. On the other hand, the expanded volume could be dredged by a WRDA environmental dredging action without any changes to the existing ROD. [150]

(c) Comments on fundamental alterations of the cost of the remedy:

Among the several concerns the HCC expressed about the increase in cost of the Hylebos Waterway cleanup from the ROD estimate of $11,080,000 to the draft ESD estimate of $39,063,000, specific concerns include:

- The ESD's more then trebling (and perhaps quadrupling, or more) of the remedy costs reflects a drastic and inappropriate departure from the ROD. [148]
- One significant cost item not included in the draft ESD, that is part of the ROD estimate, is the sampling and analysis required by EPA as part of the post-ROD pre-remedial design program. This cost is currently over $10,000,000 and expected to be $11,000,000 by completion of the pre-remedial design this year. [150]
- The current cost estimates also do not address significant potential costs associated with mitigation and land acquisition. There is currently much uncertainty associated with the mitigation that might be requested by NMFS and USFWS under the ESA and consequently there has not been a full and complete delineation of mitigation scope, performance or cost in the draft ESD.[150]

The costs associated with EPA's selection of disposal sites for Hylebos Waterway is also in direct contradiction to EPA's final ESD for PCB cleanup levels in Commencement Bay, issued July 1997. In the 1997 ESD, EPA selected a PCB cleanup level that would result in a total Hylebos cleanup volume of 508,000 cy at a cost of $18 million. EPA rejected a more stringent cleanup level, such as 300 μg/kg PCBs, because (1) it would not significantly lower human or ecological risk from Hylebos sediments; (2) it would result in substantially increased cleanup costs to $31 million; (3) it would increase the volume of sediments to be remediated by 70 percent to 891,000 cy creating the need for a second disposal site; and (4) it would result in greater disruption of aquatic organisms during dredging (See July 1997 ESD, pg. 24, Summary of the Comparative Analysis of Alternatives). These same concerns counsel against the currently proposed ESD. EPA has not provided an adequate basis for a total reversal from the positions it held in the 1997 ESD (891,000 cy and $31 million cannot be justified) to the current draft ESD (940,000 cy and $39 million is justified). [148][150]

Without inclusion of all of the cost categories defined by the ROD, including fully defined mitigation and land use costs, there can be no thorough cost totaling for the recommended remedy, no cost effectiveness evaluation, nor complete evaluation of the nine CERCLA criteria. With regards to costs, the ESD is premature and appears to be in violation of the NCP. [150]

Response 40: *The NCP provides that significant differences in the remedial action with respect to scope, performance, or cost that significantly change but do not fundamentally alter the remedy selected in the ROD should be documented in an explanation of significant differences (ESD). 40 CFR §300.435(c)(2)(i). ROD amendments, as provided in the NCP, should be proposed if the differences in the remedial action fundamentally alter the <u>basic features</u> of the selected remedy with respect to scope, performance, or cost. 40 CFR §300.435(c)(2)(ii). This ESD is consistent with the NCP. None of the basic features of the remedy selected in the 1989 ROD has been fundamentally altered, e.g., site use restrictions, source control, natural recovery, sediment remedial action, and monitoring. The information that has been developed through the pre-remedial design sampling and analysis are consistent with, and were expressly anticipated in the ROD. The increases in volume and cost are significant. However, the greater volume and cost has not led to a change in the remedial action objectives or the remedial technology selected as described in the ROD. The ESD is also consistent with EPA guidance regarding documenting post-ROD decisions. "A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents." OSWER 9200.1-23P, July 30, 1999.*

The ROD anticipated that the areal extent of contamination would be refined during remedial design. The new data indicates that there are larger areas requiring remediation than originally thought in the ROD; a significant change, but not fundamental. A group of parties agreed to conduct pre-remedial design activities in a comprehensive fashion throughout the Waterway and there were many technical and practical reasons to conduct the studies comprehensively. The ESD describes the specific manner in which the ROD is being implemented at each Waterway. Future negotiations or enforcement actions will determine who will perform the cleanup and how.

The ESD is not adding habitat function and enhancement of fisheries resources as a cleanup goal, the ROD stated that habitat function and enhancement of fisheries resources were part of the overall cleanup objectives. The ESD is not eliminating natural recovery as a part of the remedy. Approximately 20 acres in the Hylebos Waterway and 20 acres in the Thea Foss and Wheeler/Osgood Waterways are designated natural recovery areas.

See Responses 20 - 22 for discussion of subsurface contamination and remediation areas.

The increases in volume of contaminated sediment and concurrent increases in the estimated cost for the remediation are significant differences from the selected remedy. However, such increases in volume and cost has not changed the selected remedial approach of confinement, nor other basic feature of the selected remedy.

Sediment contaminated with wood debris at the head of the Hylebos Waterway that is being addressed by the Department of Ecology under a state cleanup agreement have not been added to the volume requiring cleanup under the ESD.

3.0 THEA FOSS WATERWAY

3.1 Concerns about the Cleanup

3.1.1 Source Control

Comment 41: One commentor raised several technical issues with the set up and development of the Water Quality Analysis Simulation Program (WASP) model and the subsequent conclusions about source control and recontamination that the City has based on the modeled outcomes. These technical issues are as follows: (1) Stormwater loading terms are underestimated and thus bias source control goals and recontamination potential toward less conservative estimates. (2) As presented in the Round 3 Report, the WASP model has levels of potentially recontaminating pollutants (e.g., bis(2-ethylhexyl phthalate (BEP), phenanthrene, pyrene, dibenz(a,h)anthracene) that generates a high level of uncertainty and raises important and unresolved questions about natural recovery and recontamination. (3) The commentor believes that a high-resolution hydrodynamic model, other than WASP, would provide less uncertain estimates for source control goals and recontamination potential, particularly if more recent data were used to assess particulate phase loads to the waterway. [151]

Response 41: *EPA agrees with the commentor that stormwater loading terms used by the City in the WASP model are underestimated. However, EPA does not believe that running another model would eliminate uncertainties with respect to source control goals. As early as 1995, during development of the Round 2 Data Evaluation Report, EPA stated our concerns about loading terms to the City and began asking about calibration of WASP with dissolved phase data. Theoretically, heavier PAHs and BEP should be primarily associated with a particulate (i.e., solid phase) in the waterway. However, the City still chose to use dissolved-phase loading in its calibration of the WASP model. The consequences of the preference for dissolved-phase loading are (1) the model does not calibrate well for the PAH and BEP compounds toward the head of the waterway where loads are significant and (2) the recontamination potential from* *some sources is under-predicted. For these reasons EPA recalculated particulate loads in accordance with the Model Toxics Control Act (MTCA) statistical model. Although the results are not as sophisticated as the efforts conducted by the City, they provide cause for EPA to be conservative by requiring additional stormwater source control, stormwater source control monitoring (under their National Pollution Discharge Elimination System (NPDES)permit that addresses stormwater discharge), and post-remedial monitoring of the waterway.*

EPA will likely not run a more sensitive model than WASP because the re-calculated loads are conservative enough to require the City to address stormwater control. at the same level that would be required even if a more sensitive model with larger particulate loads more accurately estimated recontamination potential.

Comment 42: One commentor noted that the load as reported in the Round 3 Report for the stormwater discharge to Superfund Sediment Management Area (SSMA) 5 was not based on current data. Specifically, stormwater sediment trap data from SD230 is not represented in the WASP loading term for that discharge to Segment 5 of the waterway. The commentor directs EPA to use this data in its final evaluation of source control for this segment of the waterway. [166]

Response 42: ***Even though the Round 3 Report does not identify a significant sediment load to the waterway for SD230, EPA, Ecology and the City are working with various data (sediment trap, whole water, catch basin and sump) to trace sources and identify effective locations for stormwater treatment. In response to this comment, it is important to note that evaluating the nature of contributing sources to municipal stormwater (e.g., flow from privately-owned and maintained drains or infiltration from groundwater through cracks or joints in the line) is an equally critical part of the decision about what constitutes effective treatment on a given stormdrain.***

Comment 43: Kennedy/Jenks and Shell Oil stated that the evidence is that municipal stormwater is the primary source of existing contamination in surface sediments and the likely source of recontamination throughout the waterway. A remedy selected without acknowledgment of this fact will fail. A remedy selected without the City's commitment to AKART analysis for controlling high molecular weight PAH (HPAH) and phthalate loads from stormwater will also fail. [157][159]

Response 43: *EPA and Ecology are working with the City to establish a level of stormwater control that will reduce phthalate and HPAH loading from stormwater to the waterway. As indicated by EPA's December 29, 1999, comments to the City on the Round 3 Report and in the Administrative Record for this ESD, the lack of certainty about stormwater loadings to the waterway is causing the agencies to be conservative in their assessment of the level of control needed to prevent recontamination of the waterway.*

Comment 44: Kennedy/Jenks commented that BEP is the greatest concern for recontamination and the principal source is municipal stormwater. The proposed remedy does not address BEP contamination. Additionally, municipal stormwater drains account for observed concentrations of PAHs in recent sediments. [157]

Response 44: *As stated in comments on the Round 3 Report, EPA believes that BEP is loading to the waterway in municipal stormwater flow. Dissolved BEP tends to adsorb to particulates, as do the HPAHs for which recontamination is predicted. EPA believes that reductions in BEP and HPAHs in stormwater are necessary, thus additional source controls on stormwater discharge to Thea Foss will be required. Both Ecology and EPA are working with the City on an action plan that includes investigation and pilot testing of structural stormwater controls that may be appropriate for the stormdrains or sub-basins. EPA and Ecology have also asked the City to develop an implementation schedule for improvements and control work. Other stormwater* *controls (e.g., continued source tracing in sub-basins, source inspections, compliance and education, ordinance for privately-maintained connections to the municipal storm lines) will add to the benefit of structural or treatment best management practices (BMPs).*

Other sources of recontamination (e.g., marinas) are not as easily controlled as stormwater and recontamination potential from these sources must also be taken into account. Monitoring is an inherent component of the remedy to continue to assess the effectiveness of source control.

Comment 45: Kennedy/Jenks provided a lengthy and detailed review of source loading terms presented in the Round 3 Report as well as an alternative calculation of source loading terms for municipal stormwater. Kennedy/Jenks identifies three particular concerns regarding the limitations on the data that the stormwater loading terms used in the City's Round 3 Report are based on. These concerns are:

- Sampling techniques used by the City did not capture the "first flush" event even though EPA guidance indicates that, typically, runoff from the first hour of a storm can carry more pollutants than a city's untreated sewage flow in that same period of time.

- The data used by the City to determine stormwater loads came from sampling conducted during wet-weather when pollutants have little time to accumulate in storm lines compared to summer and early fall storm events.

- The set of data upon which stormwater loads are based is very limited, consisting of 5 to 11 data at most for base/storm flow conditions.

Kennedy/Jenks then had the WASP model re-run with their revised stormwater loads. The revised model produced two notable results:

- With current levels of stormwater source control (i.e., stormwater loads for HPAH and BEP based on sediment and solids concentrations), the waterway would recontaminate to levels very close to current conditions.

- Without the stormwater PAH source, the head of the waterway would not require remediation. [157]

Response 45: *From information presented in Appendix G-II of the Round 2 Report (Table GII-2A), it appears that first flush from the upper half of 237A/B was captured in about half of the storms sampled. First flush from the lower half of these basins was likely discharged before either (a) personnel reached the sampling locations and/or (b) the tide went out. For smaller basins with times of concentration less than an hour (i.e., 245, 230, 254), sample collection did not begin within the first hour of any of the four storms sampled, so no first flush data are included in the estimated loading terms. EPA, Ecology and the City are discussing the that use of automated samplers to address this data gap.*

EPA concurs that the data used by the City to determine stormwater loads came from sampling conducted during wet-weather when pollutants have little time to accumulate in storm lines compared to summer and early fall storm events.

EPA concurs that loading estimates for stormwater are based on a very limited amount of data. EPA addressed this issue in comments provided to the City for both the Round 2 and Round 3 Reports. Much of the available data were qualified, and the loadings for some chemicals were calculated from as few as two samples (storms 7/10/96 and 10/18/96). For example, loads from storm drains 237A/B were calculated from a limited number of samples that were analyzed using ultra-low detection limits for LPAHs, HPAHs, pesticides, PCBs, mercury and *hexachlorobenzene, but not phthalates. The Round 3 Report indicated data with ultra-low detection limits were used to estimate loads for acenaphthylene (an LPAH) and hexachlorobenzene. Sediment trap data were used to estimate loading terms for PCBs, DDT, ideno(1,2,3-c,d) pyrene and dibenzo(a,h) anthracene (both HPAHs). Estimated loads for all other chemicals were based on whole water data with standard detection limits.*

EPA agrees with the conclusion that sediments will recontaminate without additional stormwater controls. EPA, however, strongly disagrees with the assertion that without stormwater as an ongoing source of PAHs, the head of the waterway would not require remediation. Remediation would still be required to clean up the high levels of BEP, other phthalates, PAHs and mercury present in sediments at the head of the waterway. See Response 44.

Comment 46: Kennedy/Jenks provided an alternative AKART analysis to that submitted by the City in Appendix W to the Round 3 Report and in response to the performance criteria for "approvable AKART" and additional source control for stormwater in the ESD. Briefly listed, Kennedy/Jenks' suggested additional steps to stormwater controls are:

a. Where feasible, allow stormwater to infiltrate to the ground for aquifer recharge thus reducing direct loading to waterway sediments.

b. Do additional sampling to determine the nature of stormwater loads (dissolved versus particulate phase) and best application of treatment at sub-basin level; although the performance and efficiency of sub-basin treatment is questionable due to "ubiquitous" nature of the pollutants. [157]

***Response 46:** It may be that filtration would be feasible on municipal sub-basins or at other source sites as well; however, filtration is generally space-intensive, depending on local soil permeability. As an example, one application for municipal stormwater treatment at a site in Bellevue, required two one-half acre filters for a sub-basin of approximately 250 acres. Although Appendix W to the Round 3 Report indicates that city-owned space is very limited throughout the basin, making it difficult to apply infiltration on a large scale, small sub-basins, or portions of sub-basins may be treatable and should not be discounted as Ecology, EPA and the City continue to address stormwater treatment.*

With respect to additional sampling, the City has proposed additional sampling for stormwater pollutants in both dissolved and solid phases. Ecology is currently working with the City toward approving a stormwater sampling and analysis plan (SAP) that addresses both whole water and in-line sediment traps. In addition, the City's recently proposed sampling project articulates the City's commitment to Ecology's and EPA's expressed concerns based on the quality and lack of particulate phase stormwater data.

Comment 47: As an alternative to the City's proposed AKART analysis, the commentor suggests stormwater treatment in either of two possible ways would be effective to prevent recontamination from stormwater. The first suggestion is to combine discharges for storm drains 237A/B, 230 and 235, treat it chemically, and dam the head of the waterway to add sedimentation to the combined discharge. The second suggestion is to combine the discharges for storm drains 237A/B, 230, 235 and release the combined discharges to a series of weirs installed in the waterway at the outfall for additional sedimentation, then use a wetlands constructed at the head of waterway for polishing. In detailing the basis for the alternative AKART analysis, the commentor expressed the following additional issues:

a. Kennedy/Jenks doubts that the non-structural BMPs currently in-place or being implemented on sub-basins will provide enough source control to prevent recontamination from municipal stormwater discharges. Thus, additional treatment and structural control are needed.

b. Kennedy/Jenks states that the City's presumption that the primary loads of chemicals of concern are in the dissolved phase is critically flawed as are the source control conclusions based upon it.

c. Kennedy/Jenks' comparison of the City's AKART analysis in the Round 3 Report with a previous report revealed an additional source of uncertainty in the WASP model. [157]

Response 47: *EPA appreciates Kennedy/Jenks reevaluation of stormwater treatment technologies. EPA is issuing the final ESD with performance requirements for stormwater source control which include conducting and submitting an evaluation of structural controls and a schedule for controls .*

EPA does not concur with the City's presumption that the primary loads of chemicals of concern are in the dissolved phase and is requiring additional source control for stormwater. It is most likely that a sequence of structural and/or treatment BMPs, placed strategically in each of the major stormdrain basins, will be more effective at controlling stormwater load than is predicted in the City's analysis. While correct sizing and location of structural and/or treatment BMPs is anticipated to significantly affect stormwater loads to the waterway, it is equally important to note that it is the sum of all stormwater controls, including municipal code for maintenance of private storm lines contributing to the municipal line, that will determine source control effectiveness for stormwater.

Comment 48: The City believes that the unquantified load presented in the Round 3 Report poses a greater source of recontamination than municipal stormwater. The City contends that ongoing discharges of coal tar and creosote from upland sources must be controlled and that the former MPS operation may well be contributing residual BEP to the waterway. [156]

Response 48: *EPA does not agree with the magnitude of the unquantified load presented by the City because so much uncertainty is associated with various aspects of the loading terms for stormwater. During the development of the Round 2 and Round 3 Reports, EPA, Ecology and the City had many discussions about solids normalization, model dynamics, partitioning coefficients, qualified data and detection limits. Each assumption and choice factored into the stormwater loads used in the model also carried limitations and some amount of uncertainty with it. The City pursued its decisions regarding the estimation of stormwater loads and ultimately needed a very large "unquantified source" to make the model balance. While some portion of the "unquantified source" may well be associated with assumptions made for other source load terms to the model, EPA believes that some larger amount of the unquantified portion of total load is, in fact, due to the way stormwater loads were estimated. Appendix L of the Round 3 Report acknowledges an uncertainty of 2 to 3 times for stormwater loads. The stormwater loads estimated by EPA (12/29/99) and other commentors are simply attempts to gain perspective of stormwater loads based on additional empirical data and other reasonable and conservative assumptions.*

While the City may disagree with others over the theoretical chemistry (e.g., partitioning factors) and the fate and effects of various contaminant sources to the waterway, it is the position of EPA that additional source control work for stormwater is necessary. EPA agrees that source control at other locations about the waterway (e.g., west bank seep at the Tacoma Coal Gas site, Picks Cove), including some sources contributing to municipal stormwater, is also needed. As noted in response to Comment 54, if BEP concentrations in SD 245 remain high once the MPS cleanup is complete, additional source control must occur.

Comment 49: The City believes EPA is placing undue emphasis on stormwater as a source of recontamination because stormwater outfalls are visually obvious as compared to other sources. [156]

Response 49: *EPA disagrees. Emphasis on stormwater source control is not undue given that this is a major confirmed ongoing source to the waterway. Current stormwater source investigations show there are ongoing sources of PAH, other than the Tacoma Coal Gas site, and sources of BEP, other than the former MPS site, discharging to the waterway through at least some of the stormdrains.*

The City has so far failed to acknowledge that at least some of the "unquantified" load needed to calibrate the WASP model could be associated with the limits of the data, extrapolations, assumptions, choices and decisions made in developing the stormwater load estimates. An assumption that the unquantified load is an amalgam of historic spills, groundwater infiltration to storm and seeps at the head of the waterway is not justified given the Round 3 Report places precision of the estimated stormwater loads at 200 to 300 percent. EPA does not agree with the assumption that <u>all</u> "unquantified load" is from sources other than stormwater that either have been, or can be, easily controlled.

Comment 50: The City asserts that Tacoma stormwater is no different than stormwater in other municipalities and stormwater discharge to Thea Foss is not terribly different from other Commencement Bay waterways. [156]

Response 50: *EPA does not dispute the City's contention that constituents found in Thea Foss stormwater discharge are similar to those found in other municipal stormwater discharges; however, the City's stormdrains discharge into a NPL site with contaminated marine sediments. In order for the Superfund remedy to be effective, pollutants from stormwater discharges must not be allowed to recontaminate sediments in the waterway.*

Comment 51: The City stated that comparison of stormdrain sediments to SQOs is not appropriate because empirical data and theoretical partitioning calculations indicate HPAHs and BEP do not remain in particulate phase. When stormwater enters the waterway, these pollutants desorb and are carried out the waterway in the dissolved phase. [156]

Response 51: *EPA is not using stormwater sediment trap data in direct comparison with the SQOs. As discussed in comments on the Round 3 Report (11/16/99 and 12/29/99), EPA does not agree with model's chemical partitioning or other aspects of the stormwater loading terms. EPA believes the empirical data of surface sediment quality and stormwater sediment trap data represent higher particulate phase loading from stormwater for certain HPAHs and BEP than indicated in the Round 3 Report.*

Comment 52: Tar seeps on or adjacent to the Tacoma Coal Gas site are a source of greater recontamination potential than stormwater. [156]

Response 52: *EPA believes that the Tacoma Coal Gas site represents a historical source of contamination, and that stormwater represents an ongoing source of contamination. Both historical and ongoing sources must be controlled.*

EPA is aware of the presence of seeps in the waterway or along the west bank next to the Tacoma Coal Gas site. Ecology is working with signatories of an Administrative Order under the state's MTCA on a plan to remove contaminated source material along the west bank. EPA believes that once saturated material in and at the foot of the bank are removed, a cap in the west bank area should be sufficient to prevent recontamination from this source. Because the bulk of contamination at the west bank will be removed, any shallow groundwater discharge through this area will no longer be a pathway to the sediments, EPA and Ecology believe that ongoing contamination to the waterway from the Tacoma Coal Gas site will be controlled.

Upland "hot-spots" of contamination at the Tacoma Coal Gas site do not appear to represent current or ongoing sources of contamination to the waterway. Ecology is also working with

WDOT and the City to complete construction of remedy to the "DA-1 Line" which is also associated with the Tacoma Coal Gas site. This has been a contributing source of non-aqueous phase liquid (NAPL) to stormdrain 237A and once this remedy is in place another source to the waterway will be controlled.

This leaves NAPL-saturated sediments at depth beneath the waterway as uncontrolled with respect to their potential to recontaminate the surface sediments. The cap will be designed to address potential PAH seeps from the NAPL-contaminated sediments.

Comment 53: The former Tacoma Coal Gas operation is typical of similar sites nation-wide with respect to the combinations of PAHs seen offshore and thus source control of this site is a bigger issue for recontamination than EPA has allowed. [156]

Response 53: *EPA agrees that the former Tacoma Coal Gas site is typical of such sites nation-wide and has contaminated the Waterway. The NAPL adjacent to and under the Waterway, particularly the PAH-contaminated seeps migrating from it require consideration in the design of the cap that will effectively confine the contamination and not allow recontamination of the surface of the cap. There are other sources of contamination to the Thea Foss Waterway in addition to the Tacoma Coal Gas site (e.g. stormwater) that must also be dealt with. Thus, given that sediments at the head of the waterway will be cleaned up, the concern for recontamination must be addressed from each of two perspectives. From areas adjacent to and discharging into the waterway, EPA's position on source control and surface sediment contamination are clearly documented in the Administrative Record. In the waterway, EPA is not in contention with the City or other PRPs with regard to the source of NAPLs and contamination at depth. Based on available evidence, it does appear that much additional source material was deposited in the middle of the waterway as a result of past practices. However, from the perspective of cleaning up sediments, the original source(s) of seeping NAPL is of less concern than the paths by which NAPL reaches surface sediments from depth. This is a matter of adequate remedy design rather than an issue of "source control" per se. EPA's position regarding confirmed and ongoing sources has been clarified in response to other comments from the City and the public.*

Comment 54: The former MPS operation on stormdrain 245 is a substantial source of BEP. [156]

Response 54: *EPA does not argue that the former MPS site has been a source of BEP to the waterway, however, MPS has not been the sole source of BEP loading to the waterway. Consequently, stormwater source-tracing efforts must continue as must pilot testing for BMPs to control this contaminant. Ecology is currently overseeing cleanup at the MPS site. Once cleanup is complete, the City has agreed that the storm line between MPS and the outfall should be thoroughly cleaned and resampled. If BEP concentrations remain high in stormdrain 245, then additional control for BEP on this line must be found. EPA and Ecology expect that the City's Stormwater Action Plan will address additional controls.*

Comment 55: The City believes that BEP is less toxic than the SQO of 1,300 ppb would indicate and suggests the DMMP screening level of 8,300 ppb would be more appropriate. [156]

Response 55: *The City contends that the current SQO for BEP is lower than what will actually impact benthic infauna or exhibit toxicity in laboratory bioassays. EPA has agreed with the City that biological monitoring of the remedy will be used to evaluate the toxicity of BEP if it reaches or exceeds the SQO. This is consistent with the ROD, which allows that an SQO may be exceeded but not necessarily initiate remedial action unless biological tests also fail.*

3.1.2 Recontamination of Cleanup Areas

Comment 56: Several commentors spoke to the timing and adequacy of source control with respect to construction of any sediment remedies. USFWS commented that source control should be implemented before remediation at the risk of recontamination. The Tribe commented that it is not their understanding that source control is fully implemented or yet effective to prevent recontamination. In addition, the Tribe maintains that it is necessary to implement stormwater treatment, particularly for stormdrains 237A/B, before sediment cleanup. They also expressed concerns about stormwater source control and its recontamination potential and the need for EPA to establish benchmarks for measuring source control effectiveness. [28][29][56][39][82][166]

Response 56: *From the bay-wide perspective, the entire process of source control was set forth in EPA's 1989 ROD and describes how source control is, in fact, an ongoing effort. At this point in the source control process at the Thea Foss and Wheeler-Osgood waterways, we are ending the pre-remedial design phase and entering the design phase during which the ROD allows source control will continue. In this portion of the source control process, EPA and Ecology are at the point where (1) remedial design can begin but, (2), we must be certain of the outcome on source control issues not yet resolved before starting the remedial action.*

With respect to stormwater source control, EPA is requiring the City to submit an approvable plan for controls and/or treatment to Ecology and EPA, to address source load reduction that cannot be achieved by the upstream source control actions the City has already committed to finish before sediment cleanup begins. Unlike most other source control technologies, stormwater control is an evolving area. Ecology and EPA will ensure that all practical and feasible measures will be taken on the stormdrains prior to beginning remediation.

Baseline monitoring and SQOs will be the benchmarks against which source control effectiveness will be measured.

Comment 57: WDFW commented that as EPA and Ecology work together on implementation of additional source control actions at the head of the waterway, they must give full consideration to the effects of those actions on habitat. [28]

Response 57: *EPA agrees and will ensure that source control actions give consideration to the effects of those actions on habitat.*

Comment 58: USFWS expressed concern that an unproven remedy such as sorbent pads will not provide adequate control for NAPLs that are at depth in the sediments. In turn, this would lead to recontamination, from sediments rather than surface sources, and thus to needing additional disposal with which USFWS generally disagrees. [29]

Response 58: *See Response 60.*

Comment 59: The City states its agreement with EPA and Ecology that it is about time to stop studying the problems of BMPs for stormwater source control and that it is now time to proceed with implementing them.

Response 59: *EPA agrees that BMPs for stormwater control should be implemented as soon as possible. In spite of the City's efforts to meet targets for the many and various tasks and milestones related to stormwater source control, municipal stormwater remains the last major confirmed ongoing source of contamination to the waterway for which implementation of controls is uncertain. While the major basins have recently been characterized, source tracing is an on-going effort in the larger drains. As outlined in the ESD, the stormwater action plan will include additional proactive tasks for controlling stormwater. In addition, EPA and Ecology* *continue their efforts toward evaluating installation of structural and/or nodal treatment in problem sub-basins.*

3.1.3 NAPL Contamination at the Head of the Waterway (SSMA 7)

Comment 60: Several commentors stated that the thick layer of oily sludge buried within the sediments at the head of the waterway should be removed. Unless the sludge is removed, it can continue to seep up into the water and down into the groundwater. [30][31][32][33][34][36][37][40][41][42][43][44][45][46][47][48][49][50][51][52][53][54][55][58][59][60][61][62][63][64][65][66][67][68][69][70][72][74][75][76][77][78][90][160][172]

Response 60: *While it may be technically feasible to remove the NAPL/sludge contaminated sediments from the head of the Thea Foss Waterway, the costs as estimated in the City's Round 3 Data Evaluation and Pre-Remedial Design Report would be prohibitive. Costs for the complete NAPL removal alternative were estimated to be $69 million above and beyond the cost of the remedy for the rest of the waterway. The high cost of this alternative is mainly due to the costs associated with treatment of the NAPL contaminated sediment once it is removed (approximately $58 million).*

EPA believes that the selected remedial alternative, evaluated in the Round 3 Data Evaluation and Pre-Remedial Design Report, of containing the entire volume of NAPL with a cap will be protective of the sediments in the waterway. ***EPA has added a contingency to the ESD, however, that requires additional removal of the NAPL (beyond what is being removed at the west bank) or modification of the cap design or both, if modeling and treatability studies cannot conclusively determine that the final design of the cap will be able to stabilize and prevent NAPL from migrating through the cap.***

Comment 61: The difficult situation at SSMA7 either requires a brute force approach like dredging, or an innovative contaminant removal or destruction process. Even if a removal technology only removed part of the contaminant mass, it is much more probable that it would be effective enough to be protective, and we still would have gotten rid of some of the problem. [103]

Response 61: *The selected remedy in the final ESD includes partial removal of source material along the west bank. EPA believes that removal of material along the west bank is necessary in order to prevent source material from continuing to seep into the waterway in this vicinity. In addition, some dredging of heavily contaminated sediment in the waterway will be necessary in order to provide the required navigational depth once the composite cap is constructed. Any dredged contaminated sediment will be dewatered, treated, and disposed at an off-site permitted landfill.*

Comment 62: There are a number of innovative technologies that have potential for success in the Thea Foss, even if they have not yet been applied in an under-water setting. In particular, electrokinetic technologies (such as LASAGNE) or thermally enhanced sparging have potential for actually removing *in situ* a substantial mass of the dense non-aqueous phase liquid (DNAPL) from the sediments. Most of those innovative technologies have been proven successful at upland sites at a cost of about $50 per cubic yard. Assuming it could cost twice as much to apply in the Thea Foss, the total cost of $7 million and change for remediating the 74,000 cy is comparable the currently preferred alternative. The resulting reduction in contaminant mass, along with the likelihood of greatly reduced long-term monitoring costs, would be of great benefit to the marine environment and the citizens of Tacoma. [103]

Response 62: *EPA continues to believe that confinement by capping is protective and cost effective. EPA agrees that there are promising new in-situ treatment technologies that may be able to treat NAPL contamination. Electrokinetic technologies such as LASAGNE have been* *field tested effectively at small scale sites. However, most of these technologies are currently still evolving and are not yet ready to be utilized at larger sites.*

Comment 63: If the NAPL/sludge is capped and "walled off" there should be a guarantee that it will be a permanent remedy and that there will be no leaching into the bay or ground water in the future. [36]

Response 63: *EPA has included performance standards in the ESD that ensures that if sorbent material is used for a cap it must be effective in the long term at preventing leaching of contaminants. See Response 60.*

3.1.4 Process for Selecting Cleanup Alternatives (SSMA 7)

Comment 64: The process used to select the preferred alternative for DNAPLs in SSMA 7 was flawed in that one of the alternatives least likely to be effective became the preferred alternative. The result came about by failure to follow published guidance regarding ranking and selecting remediation alternatives. The most significant factor was that the "threshold factors" for ranking alternatives (protection of human health and compliance with ARAR's) were not included in the selection process (Appendix U, Table U-8 of City's Round 3 Data Evaluation and Pre-Remedial Design Report). Regardless of other factors, an alternative is not viable if it is not protective of human health and the environment. [23, 103]

Response 64: *EPA agrees that the City's rationale and ranking of alternatives as shown in Appendix U of the Round 3 Report appears flawed but not for the same reasons as the commentor. EPA has expressed this concern in previous comment letters on the Round 3 Report. However, the City was not required to evaluate the cleanup alternatives using the NCP nine criteria. 40 CFR §300.430(e)(9). The preferred alternative for SSMA 7 as described in the draft ESD and in the City's Round 3 Report is an in situ capping alternative. In situ (in place) capping was evaluated for compliance with the threshold criteria for Superfund remedy selection (protection of human health and the environment, and compliance with ARARs) in the 1989 Commencement Bay Nearshore/Tideflats Record of Decision (ROD). Section 9 of the ROD contains the Summary of Comparative Analysis of Alternatives and Section 9.1 contains the evaluation of alternatives in relation to the threshold criteria. This evaluation concluded that the in situ capping alternative will comply with the threshold criteria.*

Section 8.3.3 of the ROD describes the in situ capping alternative as follows: "In situ capping involves containment and isolation of contaminated sediments through placement of clean material on top of existing substrate. The capping material may be clean, dredged material or fill (e.g. sand). In addition, it may be feasible to include additives (e.g. bentonite) to reduce the hydraulic permeability of the cap or sorbents to inhibit contaminant migration." The preferred alternative as described in the draft ESD includes the use of sorbent material to inhibit contaminant migration. The feasibility of using sorbent material was evaluated in Appendix U of the City's Round 3 Report. The specific sorbent material to be used will be evaluated during the remedial design phase of the project.

A detailed evaluation of the proposed remedy for the entire Thea Foss and Wheeler-Osgood waterways which includes an evaluation of compliance with the threshold criteria can be found in Section 10.3 of the Round 3 Report.

Comment 65: Another problem with the alternative selection process was more subtle, but it had a substantial impact on the final ranking of alternatives. The highly subjective high-medium-low rankings (Table U-8 of the Round 3 Report) were treated like quantitative measures that could be weighted and summed to provide a sound overall rating. [103]

Response 65: *EPA did not rely on the subjective ranking of alternatives as depicted by Table U-8 of the Round 3 Report to select the remedial action for SSMA 7. EPA's selected remedy of an in situ cap for SSMA 7 is consistent with the Summary of Comparative Analysis of Alternatives in Section 9 of the 1989 ROD.*

Comment 66: EPA uses the term "if feasible" when describing certain portions of the proposed remedy for SSMA 7 including dredging in non-channel areas and placement of a slurry cut-off wall along western edge of the waterway. Please explain what the term "if feasible" means. [82]

Response 66: *The term "if feasible" as used in the draft ESD was meant to state that the portion of the remedy would only be implemented if it could physically be constructed. EPA agrees that the term "if feasible" when describing portions of the SSMA 7 remedy is confusing and therefore has deleted this term from the final ESD.*

3.1.5 Schedule

Comment 67: The Tacoma/Pierce County Chamber of Commerce noted that EPA's timely decisions to continue the cleanup of the Thea Foss Waterway are a necessary contribution to the development of the Thea Foss Waterway. The Chamber of Commerce encouraged EPA to approve the plan as submitted so that cleanup of the Thea Foss Waterway can begin in the near future. [161]

Response 67: *EPA agrees that cleanup should begin in a timely fashion and hopes that cleanup will be integrated in the development of the Thea Foss Waterway. The ESD selects the cleanup plan for the Thea Foss and Wheeler-Osgood waterways and EPA hopes that the necessary agreements for cleanup action can be reached with the potentially responsible parties so that cleanup can begin as soon as possible.*

Comment 68: The Thea Foss Waterway was recognized several years ago as an integral component of the revitalization of downtown Tacoma. The desire for a better tomorrow and a vision for our community's future are undoubtedly what motivated our elected City Council to take their unprecedented actions for the Thea Foss Waterway. [161]

Response 68: *Comment noted. EPA recognizes and acknowledges the City for stepping forward and voluntarily agreeing to conduct the necessary pre-remedial and remedial design work prior to implementation of the cleanup action.*

Comment 69: Several commentors stated that with respect to the cleanup plan for Thea Foss, all of the relevant facts are known, all of the alternatives have been evaluated and the public has been adequately involved. These commentors urged EPA to approve the cleanup plan as submitted by the City in the Round 3 Data Evaluation and Pre-Remedial Design Report. [164][165][170][171]

Response 69: *Comment noted. See Response 67.*

Comment 70: One commentor noted that as a taxpayer and concerned citizen he was frustrated when a bureaucracy seems more concerned with process than functionality. The process seems to have caused delays in implementing cleanup and the commentor wondered why the long period of time (over 15 years) was needed to get to a cleanup decision for the Thea Foss Waterway. [163]

Response 70: *There are several reasons for the length of time it has taken to reach a decision on the cleanup plan for the Thea Foss Waterway. Prior to implementation of a cleanup plan for sediment, control of upland contaminant sources must be achieved in order to prevent recontamination of clean sediment. Ecology has made great strides over the past years in conducting the necessary source control cleanups at the numerous facilities located adjacent to and upland of the waterway. The extended time period was also needed because of the necessary* *involvement, participation and input of the numerous potentially responsible parties, regulatory, resource and trustee government agencies, and private citizens in the characterization of the nature and extent of contamination and the design of the cleanup plan for the Thea Foss Waterway.*

Comment 71: Simpson commented that they were concerned about the length of time the process has taken. They are concerned about the potential for lack of coordination in the ESA consultation process that could delay any component of EPA's overall cleanup plan.

Response 71: *EPA has coordinated with the potentially responsible parties and the resource agencies as to EPA's biological assessment. EPA will continue to coordinate with interested parties as the consultation process proceeds.*

3.1.6 Cost

Comment 72: One commentor stated that Tacoma's cost estimates reflect a more expensive remedy for the head of the Thea Foss than is needed. [158]

Response 72: *EPA agrees that the cost estimates for the proposed remedy for the head of Thea Foss Waterway as depicted in the City's Round 3 Report and the draft ESD are high. The costs are high due to the estimated cost of sorbent material to be used in the cap along with the cost of the proposed slurry wall. After further evaluation by EPA, and based on public comment and additional information submitted by the City, EPA has eliminated the slurry wall from the remedy. The elimination of the slurry wall has accordingly reduced the estimated cost for the remedy by approximately one million dollars.*

Comment 73: Some commentors stated that the estimated remedial action costs submitted by the City contain two key errors. First, with the respect to the slurry wall construction, they do not include estimates of the costs of hydrologic controls that would be necessary to make the slurry wall effective. Secondly, there are mathematical errors that understate the calculated costs by over $1 million. [157][158]

Response 73: *EPA agrees with the comment. Based on additional information gathered during underwater surveys conducted by the City and EPA along with the Administrative Record for this ESD, EPA has eliminated the slurry wall as part of the remedy. Therefore, the costs shown in the ESD do not include costs for the construction of a slurry wall. Mathematical errors have been corrected in the cost estimates outlined in the final ESD.*

3.2 ADEQUACY OF PROPOSED CLEANUP

3.2.1 Performance Criteria

Comment 74: One commentor noted that the draft ESD listed only construction and monitoring performance criteria for the sediment caps and did not include maintenance criteria. [82]

Response 74: *The cap maintenance criterion of making repairs to correct the effects of subsidence or erosion will be included in the operation and maintenance plans submitted by the PRPs.*

Comment 75: The National Oceanographic and Atomospheric Administration (NOAA) commented that the cap needs to achieve a minimum of three feet thickness after placement. In their experience, caps are not always uniformly thick over large areas. NOAA noted that the draft ESD called for an extra two feet of "overdredge" and that the capping plans should also call for extra cap material to ensure minimum three foot coverage over an entire capping area.

Response 75: *EPA agrees with the comment and the final ESD includes a performance criterion that caps must have a minimal thickness of three feet.*

Comment 76: NOAA noted that in addition to physical isolation and stabilization, caps should provide chemical isolation, preventing diffusion of contaminants through the cap surface.

Response 76: *EPA agrees with the comment and has included a cap performance criterion for chemical isolation in the ESD.*

Comment 77: Several commentors, including DNR, noted that the performance criteria listed in the draft ESD were not specific and that EPA should better define what certain criteria actually mean, and should establish a benchmark for determining when the criteria have been met. DNR noted that the desired functional characteristics of the finished grades will need to be addressed further in finalizing the design. DNR stated that in reviewing the design they want to ensure that the finished grades are adequately engineered to meet operational and ecological performance factors over a reasonably long-term project life span. [82][166]

Response 77: *The performance criteria listed in Section IV of the draft ESD and final ESD are meant to be general criteria that relate to bay-wide remedial actions. Where appropriate, EPA has added more detail to the performance criteria that are relevant to the remedial action conducted at the specific waterway (i.e. Thea Foss and Hylebos). The final ESD has also added performance criteria deemed appropriate for compensatory mitigation plans. Benchmarks and/or trigger levels will be established in consultation with the other resource agencies for determining when the criteria have been met or for instituting additional actions when necessary. Specific design criteria such as functional characteristics of the finished grades will be developed during the remedial design phase.*

Comment 78: The USFWS commented that capping materials have been described in the Administrative Record as being "coarse, large-grained sediment" in order to maintain cap integrity. The draft ESD states that one of the four functions the cap would provide will be to "provide a cap surface that promotes colonization by aquatic organisms". USFWS noted that at some point there should be a more detailed description of the composition of the cap material. USFWS also noted that in order to promote biological recolonization of species consideration should be given to closely matching the composition of the cap material to existing sediment to be capped. [29]

Response 78: *EPA agrees with the comment. Detailed descriptions of the cap material will be provided in the remedial design documents and work plans.*

Comment 79: One commentor stated that performance criteria for natural recovery and enhanced natural recovery should be added to the ESD. [82]

Response 79: *Performance criteria for natural recovery and enhanced natural recovery are that the SQOs much be achieved within 10 years of completion of the remedial action and source control. This is stated in the 1989 ROD and in the ESD. The ROD also states that only marginally contaminated sediments should be considered for natural recovery. The ESD provides further clarification that EPA considers marginally contaminated sediments as those with chemical concentrations less than the second lowest Apparent Effects Threshold (AET) value (the SQO is set at the lowest AET) or biological test results that do not exceed the minimum cleanup level (MCUL) values under Washington State Sediment Management Standards.*

3.2.2 General Comments

Comment 80: One commentor noted that the list of problem chemicals for Thea Foss/Wheeler Osgood Waterways is different from the list of chemicals of concern (COCs) developed during the pre-remedial investigations. The commentor believes that the ROD should be amended accordingly.

Response 80: *Although the magnitude and frequency of chemical exceedances represented by the chemicals of concern (COC) list does not duplicate the older table from the ROD, the primary chemical groups (HPAH, LPAH and phthalates) are present in both. EPA and Ecology are using the most current data to direct source control efforts and remediation. The table of problem chemicals listed in EPA's 1989 ROD was developed from data collected during the remedial investigation and listing phases of the Commencement Bay site. The list of COCs was developed during the pre-remedial design studies of the waterway and was intended to be a summary of the most prevalent chemicals found during these studies. It was not intended to be a comprehensive list of all chemicals present at concentrations above cleanup levels. A ROD amendment is not required because the use of additional data collected during the pre-remedial design does not represent a fundamental change to the selected remedy.*

3.3 CLEANUP APPROACHES

3.3.1 Dredging

Comment 81: Several commentors noted that the additional dredging and disposal accomplished under Alternative 5C is in response to a request from the DNR for deeper harbor depths and does not provide additional environmental protection compared to Alternative 5B. Alternative 5B is less costly, reduces the volume of sediments requiring disposal, and provides the same environmental benefits as Alternative 5C. [156][157][168]

Response 81: *EPA has reevaluated Alternative 5C and agrees with the comment that this alternative does not provide more environmental protection than Alternative 5B. As a result, EPA will not require dredging for deeper harbor depths as part of the selected remedy unless the contaminants within the harbor area sediments are above the SQOs.*

Comment 82: One commentor commented that it is not clear from the sampling data presented in the Round 3 Report that the dredging proposed for Segment 3 is necessary to remedy contamination in the waterway. The proposed remedy for Segment 3 seems intended to accomplish a substantial deepening of the waterway for navigational purposes, beyond what is necessary to protect human health and the environment. [168]

Response 82: *Dredging is necessary throughout Segment 3 because sediments exceed SQOs for several contaminants including PAHs, BEP, PCBs, pesticides and metals. Since Segment 3 is part of the federally-authorized navigational channel placing a cap over the contaminated sediments in lieu of dredging would not be feasible and would hinder navigation. Levels of contamination exceeding cleanup levels are found both in surface and subsurface sediments within Segment 3.*

The commentor focused mainly on comparing concentrations of PAHs and BEP in Segment 2 where natural recovery is selected to PAH and BEP concentrations in Segment 3. However, Segment 3 is much more contaminated than Segment 2 in that Segment 3 contains elevated concentrations of PCBs, pesticides and metals (mainly mercury). These contaminants are not likely to naturally recover within the established 10-year timeframe due to lower sedimentation rates in this segment.

Comment 83: J.M. Martinac and the City noted that the draft ESD states that "although SSMAs 5a1 and 5a3 will require no action, based on existing conditions, a portion of these SSMAs will be dredged as part of the channel slope". One bank sample collected from SSMA 5a1 in August 1994 exceeded SQOs for copper and zinc. This sample was taken prior to removal in August 1996 of bank and intertidal sediments within SSMA 5a1 that exceeded SQOs. Therefore, SSMA 5a1 has already been remediated and no action is necessary. In addition, the City's Round 1 Data Evaluation Report identifies only one bank sample in SSMA 5a3 that exceeded SQOs for any contaminant, therefore dredging should not be required in SSMA 5a3. [156][166]

Response 83: *While a bank removal in SSMA 5a1 was conducted, the removal was incomplete as areas under the docks were not remediated. In addition, no confirmatory samples were taken after the removal was completed. Sampling data for SSMA 5a3 is also incomplete so that this location will also require dredging based on the existing data. If additional data becomes available, EPA would reconsider its decision to require dredging at SSMA 5a3.*

Comment 84: Kennedy/Jenks commented that in the description of the preferred remedial action for SSMA 6B4 and 6B5 the term "if feasible" was used to describe possible dredging of these areas. They suggested that the language be modified to indicate that dredging will occur "if practicable" since nearly anything is technically feasible but it may not be practical or cost effective. In addition, Kennedy/Jenks suggested that the text in the ESD should indicate that if the contaminants above SQOs cannot be practically removed, than capping may be necessary. [157]

Response 84: *The suggested changes have been made to the ESD.*

Comment 85: Based on the ESD, depths at the mouth of the waterway will be -29 feet MLLW (SSMAs 1 and 2) whereas the depths in the adjacent, up-waterway areas (SSMAs 3 and 5) will be -32 feet MLLW. Depths farther up the waterway decrease to -21 feet MLLW (SSMA 6) but then increase to -26 feet MLLW (SSMA 7b2). Beyond this the depths taper to -13 feet MLLW (SSMA 7b3a). WDFW recommends that EPA require studies be conducted in Thea Foss Waterway to evaluate the potential impacts on circulation and DO levels within Thea Foss Waterway from these proposed contours. Monitoring of DO levels should also be conducted subsequent to the dredging activities, and over the long term, to ensure satisfactory water quality is achieved and maintained. [28]

Response 85: *EPA is aware that the remedial action for the Thea Foss Waterway will result in varying bottom elevations that could impact circulation and DO levels. EPA will require that DO levels be monitored both during dredging activities and over the long-term to ensure that water quality standards are maintained.*

3.3.2 Capping

Comment 86: As discussed in the Round 3 Data Evaluation and Pre-Design Evaluation Report (Section 2.4.2.3 and Appendix T), native material to be removed from the St. Paul site would provide suitable clean capping material for waterway areas and provide the necessary long-term isolation of underlying sediments from potential propeller wash forces. Further, because grain size characteristics of native St. Paul sediments closely match those of the waterways, use of these materials for capping would promote rapid recolonization by native benthos and epibenthos, facilitating restoration of full habitat function within the waterway capping areas. Similar conclusions have been reached on other waterways. [71]

Response 86: *EPA concurs that this is a good source of capping materials for the reasons stated above. EPA is considering the beneficial reuse options within Commencement Bay of the material removed from St. Paul Waterway.*

3.3.3 SSMA 7 Remedy—Capping and Containment Barriers

Comment 87: Other remedial technologies should be considered in addition to the slurry wall along the western edge of the waterway, such as partial removal from seeps rather than relying on highly technology-intensive remedies without adequate justification. [151]

Response 87: *Construction of a slurry wall will not be implemented because hydrogeologic data indicate that horizontal ground-water flow is not a major factor in migration of source material. Source material along the western edge of the waterway will be removed, which should help control product seepage in this part of the waterway. Ecology is working on upland removal activities in the same area. See Response 61.*

Comment 88: One commentor proposed an alternative ("adaptive management") approach for remediating the SR509 NAPL seep at the head of the waterway, given the uncertain performance and very high cost of the proposed remedy (sorbent cap) in the draft ESD. This approach included; (1) collection of additional data on the SR509 seep via visual observations during low tide and conduct of an underwater survey, and (2) removal of falsework piling related to construction of the SR509 bridge, or cutting off the falsework piles below mudline. [180]

Response 88: *EPA agrees with the comment. Since issuance of the draft ESD, EPA and the City have conducted visual underwater surveys to assess whether the false work pilings are the origin of the SR509 seeps. EPA's survey was inconclusive due to poor visibility in the waterway. The City's underway survey was more successful in that they visually documented artesian ground-water flow in the waterway. The City's survey confirmed that the NAPL seep in the waterway is most likely the result of oily material being pushed to the surface by vertical ground-water flow. The City's survey also documented that the NAPL seeps do not appear to be originating from the false work pilings. However, the falsework pilings may still be removed or cut off at mudline to facilitate construction of the cap.*

Comment 89: The City stated that they recognize the need to complete further studies, as indicated in the ESD, during final design of the remedial measures for SSMA 7. To that end, the City has contracted to prepare a work plan for design level studies of the NAPL contamination at the head of the Thea Foss Waterway. The City also stated that their current plans call for several studies to be conducted to determine the need for and optimum placement of a slurry wall and the configuration and effectiveness of a sorbent cap in SSMA 7. [156]

Response 89: *EPA acknowledges and appreciates the willingness of the City to proceed with the necessary design studies. EPA understands that since issuance of the draft ESD the City has moved forward with additional design studies. In order to ensure the final remedial design meets the remedial action objectives, the final ESD has incorporated performance standards that each component of the remedial action must meet in order for the remedial action to be effective. EPA expects that the City will perform the design studies needed to demonstrate that the components of the remedial action will meet the established performance standards.*

Comment 90: Some commentors, including Ecology, stated that there is no need for the proposed slurry wall along the western bank of SSMA 7 as proposed in the ESD and that EPA has already expressed concerns regarding effectiveness of the slurry wall to control NAPL at the head of the waterway in prior correspondence with the City. These commentors stated that the ESD should be made consistent with EPA's previously stated concerns. [157][158]

Response 90: *Based on the results of additional studies conducted by the City, the slurry wall has been eliminated as a component of the remedy. These studies have documented that the vertical groundwater gradient beneath the waterway is much greater than the horizontal gradient and therefore a slurry wall would not be effective at preventing migration of source material.*

Comment 91: There has been no evidence presented that the SR509 NAPL seep has had any significant impacts on sediment quality. This commentor believes that surface PAH contamination in the head of the waterway and elsewhere is primarily due to ongoing municipal stormwater discharges. [157]

Response 91: *Extensive sampling conducted by the City has shown that subsurface sediment located in the vicinity of the SR509 bridge is heavily contaminated with PAHs. The SR509 NAPL seep is directly linked to the massive subsurface contamination. EPA believes that the mass of contaminated sediment may be due to historical discharges. EPA agrees that the degree of contribution of the NAPL to PAH contamination in surface sediment may be overestimated in the Round 3 Report. However, if the subsurface contamination in the vicinity of the SR509 seep is not remediated it will continue to serve as a source of PAH contamination to the waterway.*

Comment 92: Some commentors stated that other than documenting the presence and approximate location of the subtidal SR509 seep, and the approximate location of the cutoff falsework piles, little work appears to have been completed as part of the City's pre-design studies to assess the cause of the SR509 seep. In their opinion, insufficient data is available for EPA to approve a definite remedy for the SR509 seep. [151][180]

Response 92: *As noted in Response 88, underwater surveys have been conducted by EPA and the City subsequent to issuance of the draft ESD. The underwater survey conducted by the City confirmed that the falsework pilings do not appear to be a preferential pathway for NAPL seeps. The City's underwater survey confirmed that product material is being forced to the surface of the waterway by vertical groundwater flow.*

Comment 93: Several commentors noted that EPA should seriously consider installing a thick sand cap in SSMA 7 considering that EPA has questioned the need for a sorbent cap in its comments to the City regarding the Round 3 Report. [157][158]

Response 93: *EPA has seriously considered installing a thick sand cap in SSMA7 and has determined that a thick composite cap, which could include sand, sorbent, and geotextile layering, could be effective at containing the NAPL in the waterway. Studies being conducted by the City must demonstrate that the composite cap would be protective of human health and the environment, and will prevent recontamination of clean sediment.*

Comment 94: Kennedy/Jenks commented that the ESD should be made consistent with EPA's views expressed in the 29 December 1999 Specific Comment Letter on the Round 3 Report. In particular, the ESD should acknowledge that the SR509 seep may be effectively addressed by a thick sand cap and additional work regarding the falsework pilings. The ESD should also acknowledge that the seep along the west bank may be more effectively addressed by removal of source material.

Response 94: *See Responses 90 - 93.*

Comment 95: Kennedy/Jenks commented that the most compelling argument for use of the thick sand cap for the head of the Waterway is the overwhelming evidence that without further stormwater controls, the extremely expensive sorbent cap is likely to recontaminate and thus require additional remedial action. [157]

Response 95: *See Responses 41 - 52.*

Comment 96: NOAA believes that it is unlikely that a sorbent cap will provide a permanent control on the release of contaminants to the waterway. Even if the sorbent cap is effective initially, the sorbent capacity of the cap will eventually be exhausted and "breakthrough" will occur, allowing contaminants to surface in concentrations comparable to those present in the absence of a cap. That is, any sorbent material has a finite capacity and when this capacity is used up, contaminant migration continues as if there weren't any sorbent present. More detailed evaluation is needed to determine the amount of sorbent required to adequately contain the NAPL sources in the waterway. [81]

Response 96: *EPA agrees with the comment in that any sorbent material will most likely have a finite capacity. Studies must prove that the sorbent material will not be exhausted over the long-term and "breakthrough" of NAPL will be prevented.*

Comment 97: The City commented that although NAPL seepage into the waterway is an easily observable fact and estimates of the mass of PAH input to the waterway from NAPL seepage are considerable, the exact mechanism by which NAPL seepage occurs is still only partially understood. The City intends to conduct additional studies including underwater surveys to further define the mechanisms of NAPL seepage. [156]

Response 97: *EPA acknowledges and appreciates that the City intends to conduct additional studies to further define the mechanisms of NAPL seepage.*

Comment 98: Some commentors, including the Tribe and USFWS, were concerned that the proposed remedy for the head of the Thea Foss (SSMA 7) will not provide for a long-term effective solution. They stated that the proposed alternative is unproven and will not be protective of human health and the environment. [23][56]

Response 98: *The remedy for the head of the Thea Foss is an in situ cap which should include the addition of sorbent material to prevent migration of NAPL. In situ caps have been proved effective at containing contamination at many sites in the Puget Sound region and across the country.*

Generic performance criteria for caps within Commencement Bay are included in the ESD in order to ensure that these caps are protective of human health and the environment. In addition, at the section entitled "Performance Criteria for the Remedial Action" additional criteria for the sorbent cap at the head of the Thea Foss were added. These additional performance criteria include; (1) the capping material must prevent NAPL from entering the waterway and recontaminating surface sediment above the SQO and, (2) if sorbent is used as capping material the sorbent must be effective in the long term and require minimal maintenance.

The cap will be composite cap consisting of sand, geotextile membranes and sorbent material as needed. Composite caps have been successfully used in the past for containing NAPL contamination. EPA agrees that the effectiveness of sorbent material at containing NAPL in the head of the Thea Foss is uncertain. As stated in previous responses, the studies currently being conducted by the City must address the uncertainties regarding the effectiveness of the sorbent material.

Comment 99: Citizens for a Heathy Bay (CHB) commented that the proposed remedy fails to address the presence of the NAPL substance. They stated that a number of questions regarding the NAPL have remained unanswered. These questions include: (1) amount of PAH loading attributable to the NAPL substance, (2) source(s) of the NAPL substance, (3) extent of the NAPL product and NAPL-contaminated sediments/soil, (4) relationship between upland and in-waterway seeps, (5) measures to control the material at its source, (6) pathways of movement to the surface, and (7) whether or not the falsework pilings provides a transport mechanism for subsurface NAPL. [67]

Response 99: *EPA believes that the removal/containment remedy selected for the head of the Thea Foss adequately addresses the presence of the NAPL. Additional characterization of NAPL by the City and any remaining questions concerning the pathways of NAPL movement will* *be addressed during the remedial design phase. Specific answers to the questions raised by the CHB are as follows:*

1. *The City conducted extensive sampling and modeling of the PAH loading attributable to all known sources of contamination including the NAPL substance. While there is some disagreement among the City, EPA and other interested parties over the results of the modeling effort, EPA believes that the PAH loading to the waterway due to NAPL seepage is significant enough to warrant product removal at the west bank and containment in the waterway.*

2. *EPA believes that the source of the subsurface NAPL substance is from historical releases from the facilities that formerly operated along the Thea Foss Waterway. This is evidenced by the presence of coal tar material along the west bank of the waterway where a coal gas plant was located and operating until the mid-twentieth century.*

3. *EPA agrees that the vertical extent of NAPL has not been well-defined in the City's Round 3 Report. Additional studies are currently being conducted by the City as part of remedial design to more accurately define the extent of NAPL contamination.*

4. *EPA believes that both upland and in-water seeps are related to historical releases. NAPL source material remains both on the bank and underneath the Thea Foss Waterway. Data provided in the City's Round 3 Report and in the Administrative Record shows that there is one large subsurface mass of heavily contaminated material within the waterway.*

5. *As stated in (4), EPA believes that the NAPL is related to historical releases, most likely from past spillages along the west bank of the waterway.*

6. *Based on recent studies conducted by the City, EPA believes that the SR509 seep may be due to oily material being forced to the surface by the vertical groundwater flow. Based on visual observations during the underwater survey, the false work pilings left in place after construction of the SR 509 bridge do not appear to be conduits for NAPL flow. The seep along the west bank is caused by product material along the bank.*

7. *See (6) above.*

Comment 100: Some commentors raised questions about the engineering of the proposed slurry wall and its stability due to existing slope stability problems along the shoreline of the head of the waterway, and due to the proximity of the proposed slurry wall to the waterway itself. [157][158][180]

Response 100: *See Response 90. Based on additional studies conducted by the City subsequent to issuance of the draft ESD, the slurry wall will not be constructed.*

3.3.4 Natural Recovery

Comment 101: The City noted that the draft ESD indicates natural recovery for areas in SSMA1 where marginal chemical exceedances of SQOs occur. The City noted that they recommended in the Round 3 Report that these areas be classified as no action areas. [156]

Response 101: *EPA has designated areas that minimally exceed the SQO as natural recovery areas consistent with Section 10.2.3 of the 1989 CBN/T ROD which establishes performance* *criteria for natural recovery. The long-term cleanup objective as established in the ROD is the SQO for problem chemicals. Sediment areas with chemicals that minimally exceed the SQO have not met the long-term cleanup objective and therefore, consistent with the ROD, cannot be classified as no action areas.*

Comment 102: The City noted that the draft ESD indicates enhanced natural recovery for areas in SSMA2 where marginal chemical exceedances of SQOs occur. The City noted that they recommended in the Round 3 Report that these areas be classified as natural recovery areas. [156]

Response 102: *EPA selected enhanced natural recovery for these areas within SSMA 2 because, as stated in the ESD, biological test results indicated some adverse biological effects for those sediments in SSMA 2 that marginally exceed the SQO. In addition, the sediment contaminant concentrations in these areas are high enough so that the long-term cleanup objective of the SQOs may not be achieved in the entire segment in the established 10-year timeframe.*

Comment 103: NOAA noted that the draft ESD stated that chemical and biological sampling indicate that the sediments in SSMA3c1 are suitable for enhanced natural recovery. NOAA questioned the use of enhanced natural recovery in a marina that may need to be dredged to maintain appropriate depths in the future.

Response 103: *The ESD has been revised to indicate that SSMA3c1 will be partially dredged to remove contaminants and provide appropriate side slopes for the navigational channel.*

3.3.5 General Comments

Comment 104: The City noted that the dredge and cap volumes presented in the draft ESD for SSMA5 and SSMA7 are incorrect.

Response 104: *EPA has corrected the dredge and cap volume estimates for SSMA5 and SSMA7 in the final ESD.*

Comment 105: The City noted that EPA does not mention SSMAs 7b3b, 7d3, 7e, 7f1 or 7f2 in the ESD: however, the City presumes the EPA concurs with the remedy for these SSMAs in the Round 3 Report. [156]

Response 105: *EPA agrees with the City's selected remedies for these areas.*

3.4 Comments on Round 3 Data Evaluation and Pre-Design Evaluation Report

Comment 106: Simpson noted that they were not in complete agreement with the cost estimates in Appendix N of the Round 3 Data Evaluation and Pre-Remedial Design Report nor with the Project Schedule in that Appendix. In their view, the costs of the CAD option, including its land and habitat elements were underestimated. [71]

Response 106: *Comment noted. Cost estimates in Appendix N are meant to be feasibility study level estimates and are designed to be within an accuracy of +50 percent to -30 percent of actual costs. Simpson did not provide details in their comment as to why they thought that the cost elements for the confined disposal option were underestimated.*

Comment 107: NOAA stated that they believe that the data on the horizontal and vertical extent of NAPL contamination presented in the Round 3 Report is insufficient. In particular, data describing the volume and location of DNAPL in relation to the local geologic strata would clarify whether the west bank is the source of all the DNAPL, the volume and depth of DNAPL requiring remediation, and the likely fate of the DNAPL, if it is left in place. Detailed data analysis may clarify if there is more than one DNAPL plume, and whether there is an LNAPL plume, also. The data presented in Appendix U (of the Round 3 Report) are insufficient to determine whether there is one plume or more, what the sources are and whether the observed floating sheens are from the light non-aqueous phase liquid (LNAPL) plume. [81]

Response 107: *EPA agrees with the comment to the extent that EPA believes that the vertical extent of DNAPL has not been defined and that the source of the NAPL seeps in the waterway has not been identified in the Round 3 Report. Since the issuance of the draft ESD, the City has conducted additional studies including sediment borings and an underwater survey in order to identify the source of the NAPL seeps and to ensure proper placement of capping material.*

Comment 108: NOAA stated that they believe that there is insufficient data and clarity in discussions in the Round 3 Report regarding a likely plume of contaminated groundwater emanating from the DNAPL. The evaluations confuse the likely migration pathway of the dissolved plume, which migrates in response to groundwater (hydraulic) gradients and the much more concentrated DNAPL plume that will migrate in response to gravity along the surface of confining layers/strata. Remediating the groundwater will not affect the DNAPL plume. [81]

Response 108: *EPA agrees that remediating the groundwater will not affect the DNAPL plume and is not selecting groundwater remediation as part of the remedy for the Thea Foss Waterway. Regional groundwater flow is toward the waterway and groundwater monitoring and extensive groundwater modeling have indicated that dissolved groundwater contamination is not a major contributor to contamination in the Thea Foss Waterway. In addition, upland source control actions being conducted by Ecology will eliminate contaminant sources to groundwater.*

Comment 109: Several commentors stated that the City has failed to demonstrate in their studies that the SR509 seep has had any significant impact on sediment quality. The commentors believe that surface PAH contamination in the head of the waterway and elsewhere (in the Thea Foss Waterway) is primarily due to ongoing municipal stormwater discharges. [157][158][168]

Response 109: *EPA believes that the SR509 seep is a source of contamination to the waterway that needs to be remediated in order to ensure that remediation efforts at the head of the Thea Foss Waterway are successful and that clean cap material is not impacted. Extensive sampling conducted during the Round 3 pre-remedial design and other studies conducted by the City clearly indicate that there is a pool of PAH-contaminated NAPL product located beneath the waterway in the vicinity of the SR509 bridge. The pool is located at the base of the recent sediment and is most likely the result of historical spillage dating back decades. Product from this pool is being pushed to the surface by the vertical groundwater flow beneath the waterway. The seep however, is not the only source of contamination to the sediment and the waterway. EPA agrees with the commentors that stormwater is an additional source of contamination to the sediment.*

Comment 110: EPA has presented in its November 18, 1999 General Comment Letter on the Round 3 Data Evaluation Report, and reiterated in their December 29, 1999 Specific Comment Letter uncertainties about the necessity for, and the effectiveness of the proposed sorbent cap. Further, EPA has indicated that there are current uncertainties regarding whether the in-waterway NAPL seep impacts sediment quality at all. We concur with this statement. [157]

Response 110: *EPA agrees that the effectiveness of sorbent material at containing NAPL in the head of the Thea Foss is uncertain. As stated in previous responses, however, the treatability studies currently being conducted by the City must address the uncertainties regarding the effectiveness of a sorbent cap. See also Response 109.*

Comment 111: Although a description of the thick sand cap alternative is provided in Attachment N-1 of the Round 3 Report, it was not included in the City's alternatives evaluation ranking presented in Appendix U and not given serious consideration in the Round 3 Report. [157]

Response 111: *The thick sand cap was described in Attachment N-1 of the Round 3 Report as an interim remedy. EPA believes that the thick sand cap has merit provided that NAPL related to the two in-waterway seeps is removed and is effective at containing NAPL and preventing recontamination of clean cap material.*

Comment 112: Kennedy/Jenks revised the ranking of alternatives in Table U-8 in Appendix U of the Round 3 Report to compare the thick sand cap alternative to other alternatives evaluated in the Screening Level Feasibility Study of SSMA7. Kennedy/Jenks also provided a narrative comparison of the thick sand cap to the sorbent cap proposed in the Round 3 Report and the draft ESD. In the revised ranking the thick sand cap scored higher and the commentor concluded that the thick sand cap is thus preferred over the other alternatives. [157]

Response 112: *As stated above, EPA believes that the thick sand cap has merit provided removal of source material is effective at containing NAPL and preventing recontamination of clean cap material. The revised ranking of alternatives conducted by the Kennedy Jenks did not include removal of NAPL source material that EPA believes is a critical component in evaluating the effectiveness of a thick sand cap.*

3.4.1 Habitat Mitigation

Comment 113: DNR noted that Wheeler-Osgood Waterway offers the potential for significantly enhanced functions for mudflat intertidal and shallow subtidal habitats. DNR stated that reconnection of the Wheeler-Osgood Waterway to the Puyallup River would substantially benefit sediment functions over the long term. DNR noted that controlled cross delta inputs of Puyallup river water, suspended sediments and organic debris (detritus) could substantially increase the estuarine functional values and would also be beneficial to sustaining a higher level of sediment function for remediated areas throughout the Thea Foss Waterway. [155]

Response 113: *EPA is requiring habitat mitigation for the loss of 4.6 acres of intertidal habitat due to remediation activities in the Thea Foss and Wheeler-Osgood waterways. Likewise, any other unavoidable impacts from the remedial actions, including disposal sites, must be mitigated. The DNR proposal to provide cross delta inputs of Puyallup river water, suspended sediments and detritus to the Wheeler-Osgood Waterway for habitat mitigation has not been offered as an option by any party responsible for mitigating for CB/NT impacts. If such an option were proposed by the potentially responsible parties, EPA will consider it.*

Comment 114: DNR commented that in their assessment, the limited existing habitat values of Thea Foss Waterway rank it along with Blair Waterway, as the poorest choice in Commencement Bay for any investment in habitat enhancements beyond source control and remediation. DNR supports cleanup and source control in the Thea Foss Waterway to provide water column and substrate that will meet water quality standards and questions any small scale habitat projects in the core urban area when there are alternative sites in Commencement Bay that will provide greater benefits. [155]

Response 114: *Comment noted.*

Comment 115: The Tribe is opposed to the loss of approximately 5 acres of intertidal habitat as of part the proposed remedy for the Thea Foss Waterway. The Tribe believes that every effort should be made to protect, cleanup and enhance existing intertidal habitat. If cleanup demands removal of contaminated intertidal sediments, then backfilling to the original elevation and appropriate enhancement will prevent any further loss of in-waterway intertidal habitat.

***Response 115:** Every effort will be made to minimize loss of intertidal habitat during cleanup activities.*

Comment 116: The City commented that Alternatives 5B or 5C would result in a conversion of 4.31 or 4.64 acres of intertidal and shallow subtidal area to 4.1 or 4.59 acres of deeper water habitat, for a net difference of 0.21 or 0.06 acre of marine habitat, respectively. This small net difference in habitat area is minor when compared to the scope of the remediation and the associated positive improvements in sediment quality over 60 + acres of habitat and the associated improvement in the overall health of the marine environment of the Thea Foss Waterway. It is the City's position that because of the net long-term improvement in habitat function that would result from remediation, no compensatory mitigation is warranted. [156]

***Response 116:** Even though the cleanup of the Thea Foss Waterway will be beneficial to the environment, to comply with ARARs, unavoidable loss of habitat must be compensated, regardless of the purpose of the project. It must be remembered that releases of hazardous substances to the environment is the reason the cleanup is required.*

Comment 117: The CHB does not support the City's conclusion that cleanup in the Thea Foss Wheeler Osgood waterways Superfund site is sufficient mitigation for the more than 4 acres of habitat that will be lost through this cleanup action. Within the CBN/T area, less than 5 percent of the original Nearshore, mudflat and salt marsh habitats remain. What does remain will continue to be at risk by urban and industrial impacts, shoreline development and both point and non-point sources of pollution. The CBN/T ROD established SQOs to protect the aquatic environment stresses the fact that improvement to aquatic habitats is an expected outcome of Superfund cleanup activities. While remedial activities within the waterways will achieve long term improvements to the aquatic and Nearshore environment, these improvements are offset by short-term adverse impacts to that same environment. Removal of the contaminated sediments removes aquatic populations from those same areas. Those populations will decolonize but levels of stability, productivity and community structure, comparable to similar habitats and depths elsewhere in Commencement Bay, will require time to develop. [67]

***Response117:** EPA agrees with the comment. See Response 116.*

Comment 118: One commentor stated that EPA should not settle for a Thea Foss cleanup plan that destroys some of the small amount of remaining habitat area without mitigation. The commentor requested that EPA require that all of the habitat lost in the cleanup process be fully compensated. [67]

***Response 118:** See Response 116.*

3.5 Use of St. Paul Waterway as a Disposal Facility

3.5.1 St. Paul Habitat Mitigation Plan

Comment 119: WDFW does not support the notion that the proposed mitigation provides adequate habitat area or function to adequately compensate for the loss of habitat associated with the proposed filling of the St. Paul Waterway. WDFW concurs with EPA's suggestion on page 24 of the ESD that Simpson " provide additional mitigation up front". WDFW believes this would be necessary not only to address uncertainty factors associated with the proposed mitigation, but also to fulfill the fundamental objective of providing adequate mitigation area and function to fully compensate for impacts to fish and wildlife resources that would result from the proposed fill. [28]

***Response 119:** EPA agrees that there are uncertainties with respect to the functional aspects of the mitigation plan. EPA is requiring that additional mitigation up front be provided to account* *for the potential risk of mitigation failure. Additionally, a freshwater source from the Puyallup River to the Middle Waterway that would allow transfer of Puyallup River water is considered necessary to assure full function of the St. Paul mitigation project.*

Comment 120: WDFW and USFWS stated that limitations of the mitigation proposal for St. Paul Waterway are further accentuated by the plan to relocate the log haul-out facility to the middle of the mitigation site. This will necessarily involve industrial activity within the aquatic portions of the mitigation site introducing noise, prop wash, bark debris, and other associated disturbances to fish and wildlife that may utilize the area. While recognizing that Commencement Bay is a highly industrialized urban area, it is still important to strive for creation of mitigation areas that are largely devoid of industrial activities to further enhance use of these areas by fish and wildlife. [28][29]

Response120: *The log haul-out at the head of St. Paul Waterway will be relocated to the western side of the St. Paul/Middle peninsula within the Middle Waterway. The facility has been located and designed to minimize the aquatic footprint and avoid and minimize impacts to the aquatic environment, to meet the best management practices in the City shoreline program, and to comply with practices recently agreed upon for log haul out by the Wood Debris Group in Hylebos Waterway (e.g., no log grounding, bark control). Design details of the proposed facility will still need to be approved by EPA, which may result in further mitigative measures.*

Comment 121: USFWS believes that the proposed mitigation discussed to date for fill of the St. Paul Waterway is inadequate in replacing both the acreage and functional loss to fish and wildlife resources. USFWS stated that the proposed mitigation site in the Middle Waterway does not provide the same level of use by juvenile salmoides for the following reasons:

1) The proposed mitigation is based on the creation of an intertidal marsh, yet Simenstad's baywide assessment document states that: "Given the present highly-restricted or lacking delivery of freshwater, sediments and nutrients to the restoration sites in Middle Waterway, the prospect of long-term sustainability of brackish-oligohaline marshes appropriate to this region of the delta is uncertain, if not dubious."(Simenstad 1999.)

2) The Middle Waterway channel feasibility study conducted by the Corps at the request of the EPA did not, in USFWS's opinion, present a reasonable, cost-effective alternative for providing a freshwater source to the proposed mitigation site. Simenstad's report also states that: "...the only alternative to prevent rediversion of a significant portion of the river flow and bedload sediments would be to construct a major and extremely costly control structure." (Simenstad 1999.) To date, USFWS has not reviewed a complete proposal that would sufficiently provide a freshwater source to adequately support the types of habitats proposed. [29]

Response 121: *EPA agrees that a permanent freshwater source to Middle Waterway is necessary to achieve full habitat function in Upper Middle Waterway for pre-smolt juvenile salmon.*

The St. Paul Habitat Plan (April 2000) notes an option for supplying freshwater from the Puyallup River via rehabilitation and use of a City of Tacoma soon-to-be-abandoned water line along 11th Avenue that will become available in the year 2000 after a new water line is constructed. This pipeline option could potentially allow transfer of the necessary volume of fresh water to the Middle Waterway to achieve immediate benefits to salmonids, including development of brackish marsh habitat. In the future, the pipeline could provide fresh water to potential restoration of intertidal brackish marsh and tidal channel habitats in the Delta Reserve/former industrial properties south of 11th Avenue. EPA is requiring that this pipeline option, and other fresh water source(s) as necessary to meet the volume specifications, be *implemented to assure full function of the mitigation project and, in part, to compensate for resource losses from the remedial activities in the Thea Foss Waterway.*

Comment 122: NOAA stated that the mitigation package developed by Simpson for the St. Paul fill is large and complex, and all of it may not work as planned. NOAA requested that Simpson can either provide a very detailed contingency plan for acceptance by the resource agencies to address the significant uncertainties with the plan, or they can construct additional mitigation up front. If the functional attributes of the originally planned habitat do not meet target levels of performance at agreed upon dates, the additional habitat constructed up front would offset the deficiency. If the created habitat does function as planned, then any excess mitigation could be made available to other liable parties at a marketable credit. Of the two approaches, NOAA prefers the later because it will be more protective of natural resources and will reduce temporal losses of habitats and services. [81]

Response122: *See Responses 119 and 121.*

Comment 123: One commentor stated that EPA should not settle for a Thea Foss cleanup plan that destroys some of the small amount of remaining habitat area without mitigation. The commentor requested that EPA require that all of the habitat lost in the cleanup process be fully compensated. [67]

Response 123: *See Response 116 and 121.*

Comment 124: Several commentors support the compensatory mitigation plan that Simpson Tacoma Kraft has developed to offset losses due to the proposed Nearshore fill. Some commentors urged EPA to retain the adaptive management and stewardship program components of the plan as the plan components are likely to provide for a high success rate for the proposed habitat areas. [39, 57, 81, 101, 156]

Response 124: *Comment noted. The adaptive management and stewardship programs are important components of the St. Paul fill mitigation plan.*

Comment 125: Ecology stated that they agree with and support EPA's concerns regarding the mitigation proposed for the St. Paul Nearshore fill. Specifically, whether the amount and value of the mitigation proposed adequately compensates for the loss of the St. Paul habitat and meets the goals of the ESA, the Commencement Bay Aquatic Ecosystem Assessment, and the National Wetlands Policy Forum. Ecology is concerned that the relocation of the log haul-out facility to the Middle Waterway may degrade and jeopardize ongoing and future restoration efforts within Middle Waterway. [85]

Response 125: *Comment noted. See Response 120.*

Comment 126: Simpson commented that EPA should consider the connectivity and cumulative functional values of the habitat components in the lower watershed and neodelta as additional contribution or margin of safety for any one component of the habitat plan. [71]

Response 126: *EPA believes that we have appropriately factored these components into our assessment. EPA evaluated the remedial actions themselves on a watershed basis with regard to potential impacts. Our consideration of compensatory mitigation requirements also involved a bay-wide scope, relying very heavily on the analysis and findings in the Simenstad report (2000). Connectivity and cumulative functional values are fundemental to future compensatory mitigation plans that would be approved by EPA, as is risk. The compensatory mitigation plan for the St. Paul Waterway Nearshore Facility is judged to be consistent in concept with the conservation and recovery strategy for ESA-listed species in the Simenstad report. The habitat components noted by Simpson in their comment provide EPA with some assurance that once* *the habitat is constructed and made fully functional, the mitigation <u>should</u> contribute positively to the Commencement Bay aquatic system and be located such that other, future mitigation or restoration actions could connect to it. This unrealized potential does not reduce the fundemental risk that this created habitat may in fact not function as Simpson presently describes and as EPA and others hope. Additionally, there is no assurrance that the potential connectivity of the habitat components to other habitat improvement projects will be realized.*

Comment 127: While the relocation of the log haul-out is mentioned here, there is no discussion of Simpson's proposed outer Middle Waterway dock. Will this project be evaluated under a separate Corps 404 permit, or is it an integral part of the cleanup and fill project? NOAA does not have enough information to provide comments on mitigation for this project, but we expect that mitigation will be needed. [81]

Response 127. *The relocation of the log haul-out is part of the CERCLA cleanup but the dock to be located in the Middle Waterway is not part of the CERCLA action. Mitigation for the log haul-out is addressed in the April 2000 "Habitat Plan and Design Report; St. Paul Waterway Nearshore Facility" which was distributed to the natural resource agencies for review. EPA did not consider impacts of the proposed Middle Waterway dock in reviewing the mitigation plans because it will undergo a separate permit process.*

4.0 MIDDLE WATERWAY

Comment 128: The draft ESD states that a separate ESD will be prepared on the cleanup plan for Middle Waterway. MWAC and Simpson believe that an ESD for Middle Waterway is unnecessary unless the sediment volumes, cleanup plan and disposal options are dramatically different than discussed in the ROD and ESD. [57]

Response 128: *The 1989 ROD estimated that 57,000 cy of contaminated sediments would require active remediation in the Middle Waterway. The investigations and studies undertaken by MWAC since the ROD was signed have resulted in the identification of higher volumes of sediments that would be subject to remedial action than originally estimated in the ROD. MWAC currently estimates that 75,000 to 100,000 cy of contaminated sediments may require remedial action, which is almost twice the original estimate. In addition, the increased volume may result in a large increase in the estimated cost of the remedy outlined in the ROD. While these changes will not result in a fundamental change to the remedy selected in the ROD, the differences are significant and will be documented in an ESD. Even if the final volume is closer to the ROD estimate, EPA plans to issue an ESD for all CBN/T waterway cleanup plans, as a means of informing the public about the specific implementation of the CBN/T site-wide cleanup plan for each waterway.*

Comment 129: How can EPA expect to reserve space for the Middle Waterway sediments in one of the disposal sites? The disposal site owners have the right to say who dumps what onto their private property. EPA can expect that space would become available but that doesn't make it so. EPA needs to include assurances from the land owners that the Middle Waterway sediments would be welcome in any one of the proposed sites. And second—how can EPA expect to reserve space for the Middle Waterway sediments when there is no cleanup plan for the Middle Waterway? EPA should include the Middle Waterway cleanup plan in this ESD or make the disposal site selection in a separate ESD along with the cleanup plan. [57]

Response 129: *EPA's selection of disposal sites is intended to accommodate contaminated sediments dredged from the Thea Foss, Wheeler-Osgood, Hylebos, and Middle waterways. Therefore, the selected disposal sites must have sufficient disposal capacity to contain the projected volume of contaminated sediments that will be dredged from the Superfund project and any additional dredging by the Corps, the Port, or private parties during the Superfund cleanup.*

The Middle Waterway PRPs have estimated that approximately 75,000 to 100,000 cy of contaminated sediments may require disposal. EPA expects dredged contaminated sediments from the Middle Waterway to be disposed of in the sites selected in this ESD. The City has recommended to EPA that the Thea Foss and Wheeler-Osgood contaminated sediments be placed in the St. Paul Nearshore Fill and, if possible, also the contaminated sediments from Middle Waterway. EPA supports this proposal but reserves the flexibility to allow the PRPs to make adjustments during design based on final disposal capacity.

Comment 130: The baywide assessment states that due to habitat modifications, most osmoregulatory adaptation to salinity by out-migrating juvenile salmonids must take place along the brackish edges of the river plume. The landscape perspective outlined in the document identifies seven strategies that would offer the greatest contribution to the estuarine life history of chinook and other salmon in the watershed. The first strategy is to preserve relict habitat patches as building blocks for future mitigation (Simenstad 1999). The St. Paul Waterway is influenced by the plume of the river and is therefore within the area that is currently utilized for osmoregulatory adaptation by out-migrating juvenile salmonids. The waterway is also composed of 13.6 acres of relict intertidal and shallow subtidal mudflats. Sampling for juvenile salmonid usage in the waterway is limited. However, a 1997 study showed significant use of the St. Paul Waterway by both chum and chinook salmon, and limited use of the Middle Waterway by chinook salmon (Parametrix, Inc. 1997). In conjunction with the scarcity of intertidal habitats, this information further supports our continued concern with the filling of the St. Paul Waterway, and further questions the adequacy of the proposed mitigation for this alternative disposal site. [29]

***Response 130:** EPA shares the concern regarding loss of critical habitat. In developing a strategy to meet EPA's responsibility for cleanup and to support bay-wide salmon recovery efforts, EPA faced many difficult choices and has been presented with many obstacles to using deeper, subtidal areas in the Bay for disposal. EPA analyzed the impacts of the remedial actions on the aquatic environment in compliance with Section 404(b)(1) of the Clean Water Act. Because removal of contaminated sediments (i.e., dredging) creates the need to dispose of contaminated sediments somewhere, EPA recognized that finding disposal sites and mitigating for adverse effects required a geographical scope beyond individual waterways. EPA maintained a Commencement Bay-wide perspective in formulating and evaluating remedial action plans and requirements for mitigation in order to ensure that ecological gains result from its cleanup actions. While specific actions and schedules within each individual waterway may vary owing to site-specific conditions, the specific and collective activities of each remediation will cumulatively contribute to practical and measurable improvement to aquatic habitat functions where they are most needed in the watershed. See Response 134.*

5.0 BAY-WIDE CONCERNS

5.1 Bay-wide Restoration Planning

Comment 131: NOAA and the Ecology trustee representative note that due to the scarcity of aquatic and nearshore habitat available for restoration opportunities and the recent ESA listings, cleanup and disposal decisions must be made under a baywide planning and evaluation effort, especially for threatened/endangered trust resources and their habitats. For example, the Hylebos CAD proposal suggests, rather than rebuilding the original bathymetry of the aquatic habitat, modifying it to a depth more beneficial to salmon, and planting vegetation.[81][85]

***Response 131:** A baywide assessment of impacts and potential enhancement of salmon habitat was an important consideration in EPA's selection of disposal sites and review of mitigation plans. See Responses 130 and 135.*

Comment 132: DNR notes that a major issue for them is the assumption that physical removal or isolation of contaminants from the surface sediment environment alone will satisfy the objective of habitat function and fisheries resources enhancement. DNR expects that significant adjustments in design may be required to achieve the habitat function and fish resources enhancement objective as a result of incorporation of estuary landscape restoration considerations. [155]

Response 132: *EPA has sought to incorporate habitat function and fisheries resources enhancement in every decision made in the cleanup process as we implement the ROD. In assessing suitable compensatory mitigation measures, EPA has and will continue to rely upon the framework for the Commencement Bay-wide conservation and recovery strategy in the Simenstad Report, along with data developed during consultation with the Services. The strategy of the Simenstad report focuses on broad landscape attributes and ecosystem processes (i.e., landscape ecology) that promote juvenile salmon utilization of existing and potential Puyallup River delta and Commencement Bay habitats. Drawing from the Simenstad report, EPA has identified "performance criteria" that must, at minimum, be included in any acceptable compensatory mitigation plan. These performance criteria are listed in Section IV the ESD and in the 404(b)(1) evaluation for the cleanup.*

Comment 133: MWAC is opposed to any proposal that would create a tributary or channel from the Puyallup River to the Middle Waterway, as some have suggested. Not only do we believe that it is infeasible in light of existing land use conditions and sediment loads, we believe that such a proposal poses a high risk of scouring the existing productive remnant original mudflat. We agree with Charles Simenstad's conclusion in his Commencement Bay Aquatic Ecosystem Assessment Report that an excessively engineered freshwater channel will divert critical funds and efforts from more functional habitat restoration alternatives. MWAC believes that public and private funds would be better spent and distributed on smaller, more feasible restoration projects elsewhere in Commencement Bay. [57]

Response 133: *EPA is not requiring in the final ESD that a tributary or channel be constructed from the Puyallup River to the Middle Waterway. However, EPA is requiring that a permanent freshwater source be provided to upper Middle Waterway. See Response 121.*

5.2 404(b)(1) Evaluation

Comment 134: I am quite concerned with the prospect of filling in more intertidal/nearshore habitat in the bay, even if it is to support cleanup efforts, considering that a staggering proportion of the original tideflats and marshes have already been filled. The National Wetlands Policy Forum, convened at the request of EPA in 1987, recommends as an interim goal, "achieve no overall net loss of the nation's remaining wetlands base", and a long-term goal of "increase the quantity and quality of the nation's wetlands resource base." Regardless of mitigation, if the filling of St. Paul and Blair Slip 1 go forth, these sites will be made permanently unavailable as existing habitat and as future restoration opportunities. [85]

Response 134: *EPA recognizes the significance of the impacts to intertidal habitat from use of the St. Paul and Blair Slip 1 areas as disposal sites. However, the extensive areas of sediment contamination in Commencement Bay are also negatively affecting habitat. The 1989 ROD designated dredging and capping as remedies to address contaminated Commencement Bay sediments. Dredging will result in the need to dispose of approximately 1.6 million cy of contaminated sediments. EPA analyzed the impacts of the remedial actions on the aquatic environment in compliance with Section 404(b)(1) of the Clean Water Act. Because removal of contaminated sediments (i.e., dredging) creates the need to dispose of contaminated sediments somewhere, EPA recognized that finding disposal sites and mitigating for adverse effects required a geographical scope beyond individual waterways. EPA maintained a Commencement Bay-wide perspective in formulating and evaluating remedial action plans and requirements for mitigation in order to ensure that ecological gains result from its cleanup actions. While specific actions and schedules within each individual waterway may vary owing to site-specific conditions, the specific and collective activities of each remediation will cumulatively contribute* *to practical and measurable improvement to aquatic habitat functions where they are most needed in the watershed. EPA has sought to avoid and minimize adverse impacts to the extent possible. Unavoidable impacts must be compensated consistent with performance criteria that are based on the bay-wide conservation and recovery strategy. EPA's 404(b)(1) evaluation is summarized in the ESD and the full evaluation is included in the Administrative Record. See Response 132.*

Comment 135: We appreciated the opportunity to review the draft 404(b)(1) analysis and were impressed with the organization of the document for the complexity of issues and proposed actions. We would like to see the final 404(b)(1) analysis acknowledge the acceptability of the proposed habitat plan for the St. Paul facility and the reliance upon the final adaptive management plan to address any uncertainties, as discussed above. [71]

We also request that the 404(b)(1) analysis be updated on p. 19 to list the "Habitat Plan and Design Report for the St. Paul Waterway Nearshore Facility" (Parametrix, February 2000), which is Appendix Z of the Round 3 Data Evaluation and Pre-Design Evaluation Report, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington. Appendix Z was circulated in the fall to EPA and all of the natural resource agencies, as was the final Round 3 Report. This appendix has since been updated to reflect comments from EPA Region 10 Aquatic Resources Branch and the monthly interagency St. Paul habitat project planning and design meetings. This report was prepared specifically for the purpose of serving as a supporting technical document for the ESD, 404(b)(1) and BA documents. [71]

***Response 135:** It is not possible for EPA to provide it's final determination on the acceptability of the proposed habitat mitigation plan for St. Paul Nearshore Fill at this time because EPA has not been provided with final design plans and specifications for the St. Paul Nearshore Fill project and the Thea Foss remediation project.*

But based on existing information, EPA is uncertain of the ability of the Upper Middle Waterway mitigation area to fully function as claimed. Accordingly, EPA has determined that the risk of mitigation success/failure must be specifically factored into habitat plans and provided for up-front rather than solely as a post-construction contingency. Additionally, a freshwater source from the Puyallup River to the Middle Waterway that meets the criteria listed in Section VI.B. of the ESD is considered necessary to assure full function of the mitigation project and, in part, to compensate for resource losses from the remedial activities in the Thea Foss Waterway. Please see our complete findings in the final ESD and 404(b)(1) evaluation. EPA's decisions are based on review of the April 2000 "Habitat Plan and Design Report; St. Paul Waterway Nearshore Facility" (which is an updated version of the document mentioned in the comment).

Comment 136: Some commentors asserted that EPA proposed three disposal sites (Mouth of Hylebos, St. Paul Nearshore Fill, and Blair Slip 1) without demonstrating that this is the least impact practical alternative, as required by Section 404 of the Clean Water Act. They commented that EPA had not adequately evaluated other alternatives, such as the use of one disposal site at the Mouth of Hylebos, that would greatly reduce loss of habitat in Commencement Bay while at the same time lowering the cost of cleanup.

They note that EPA did not provide a clear rationale regarding the use of the three sites rather than one. Although it is suggested in the Substantive Compliance document that no single site could contain all of the material, this statement is then qualified by the observation that this would be possible through some configuration of the Mouth of the Hylebos CAD. At no point is a limit placed on the capacity of this site and, in the Explanation of Significant Differences document, it appears that this site will only receive material which is beyond the capacity of the other two sites.

They also noted that minimizing the number of sites would have better avoided potential cumulative impacts. Use of two of the sites will result in the loss of aquatic habit, including some classified as Special Aquatic Habitats. Again, the use of the Mouth of Hylebos CAD site will not only avoid these losses but will actually constitute an environmental enhancement. As the Mouth of Hylebos CAD could contain all of the material while the Blair Slip 1 and the St. Paul sites will not, a prudent approach would be to use the Mouth of Hylebos CAD alone rather than all three sites. In addition, the 404(b)(1) Guidelines at 40 CFR 230.10(a) require the use, where practicable, of the alternative which has the least adverse impact on the aquatic ecosystem.

From the above, the commentor concluded that the Mouth of Hylebos CAD site will have the least impact upon aquatic habitats, will require no mitigation (indeed, with proper design, it will be an environmental enhancement), and can contain ALL of the dredged material (other than some small amount that may need to be disposed at a regional landfill). This being the case, it is not clear why the other two aquatic sites were selected.

Consequently the recommended plan violates the CERCLA criteria for compliance with the substantive requirements of ARARs (Applicable, or Relevant and Appropriate Requirements)—specifically Section 404 of the Clean Water Act. [89][150]

Response 136: *EPA does not agree with the commentors' assertion of violation of the requirements of either the Clean Water Act or CERCLA. EPA carefully evaluated a large range of alternatives for suitable disposal and developed selection criteria to determine the least environmentally damaging practicable alternative. The practical alternatives analysis was consistent with the project purpose of the 404 evaluation, which is: to remediate contaminated Commencement Bay problem areas consistent with the ROD cleanup objectives and, in a manner that is, to the maximum extent practicable, consistent with and supportive of the conservation and recovery of ESA-listed species. In its evaluation, EPA considered site availability, cost-effectiveness, feasibility, avoidance and minimization of impacts to the aquatic environment, and avoidance of jeopardy to and contributions to conservation and recovery of ESA-listed species. These criteria are consistent with Section 404(b)(1) guidelines. However, as a result of public comment and further discussions on the proposed disposal sites, the Mouth of the Hylebos CAD was withdrawn, which resulted in significant reevaluation of the impacts and potential bay-wide improvement from the remedial actions. The final ESD and 404(b)(1) evaluation provides more detailed descriptions of that analysis.*

EPA's major concern with in-water disposal was the need to evaluate the practical alternatives and the cumulative impacts of those sites on a bay-wide basis. EPA maintained a Commencement Bay-wide perspective in formulating and evaluating remedial action plans and requirements for mitigation in order to ensure that ecological gains result from its cleanup actions. It was also EPA's goal that while specific actions and schedules within each individual waterway may vary owing to site-specific conditions, the specific and collective activities of each remediation will cumulatively contribute to practical and measurable improvement to aquatic habitat functions where they are most needed in the watershed. EPA also wanted to assure full capacity for all disposal actions.

The Mouth of Hylebos CAD was considered a priority site because of its location and possible size, and was proposed as a disposal site in EPA's draft ESD. However, conflicts with local Coastal Zone Management Act designated land use and several unresolved issues have led EPA to the conclusion that the Mouth of Hylebos site is not available for use as a disposal site. The unresolved issues are described in the revised 404(b)(1) analysis and include: (1) DNR's stated preference that CADs only be used for temporary disposal while EPA sees them as a long-term solution; (2) lease rates for use of state-owned, aquatic land; and (3) need to relocate an existing lease holder at the mouth of the Hylebos. EPA determined that a considerable amount of time would be needed to resolve these issues, and that the site could not be made available in time for EPA to use it as a disposal site for the Hylebos Waterway cleanup, which does not meet the project purpose. Blair Slip 1, St. Paul Waterway and an upland regional landfill are available for use, feasible, and cost effective. The only available disposal site which could *potentially contain all Commencement Bay contaminated sediments is an upland regional landfill. The cost and logistics, however, make use of an upland regional landfill for all contaminated sediments dredged from the CB/NT site impracticable. During RD, some volume of sediments from any of the three waterways may be found to have physical or chemical characteristics that requires their removal to the upland environment. Additionally, none of the available aquatic sites have the capacity to accept the present estimated volume to be dredged. Accordingly, contaminated sediments also will be disposed at the an upland regional landfill.*

Comment 137: The Mouth of Hylebos site has the least habitat impacts to Commencement Bay of the practicable disposal sites identified by EPA. As discussed in the draft ESD, filling St. Paul Waterway results in the loss of 13.6 acres of aquatic habitat, 7.6 of which are mudflats, a protected special aquatic habitat under Section 404 of the Clean Water Act. Section 404 maintains that degradation or destruction of special aquatic sites such as wetlands and mudflats represents an irreversible loss of valuable aquatic resources that should be avoided. Filling Blair Slip 1 results in the loss of 13.1 acres of aquatic habitat, including 3.1 acres of intertidal and shallow subtidal habitat, none of it classified as mudflats. The aquatic habitat loss by the draft ESD totals 26.7 acres, 10.7 of which are mudflats or intertidal/shallow subtidal habitat. Once the least impactive practicable alternative is selected, then and only then can mitigation be considered in the Clean Water Act Section 404 process. [150]

***Response 137:** The mouth of the Hylebos CAD is not practicable because it is not available. See Response 136.*

Comment 138: Use of the St. Paul and Blair Slip 1 sites will result in a loss of 26.7 acres of aquatic habitat, including 7.6 acres of mudflats (Special Aquatic Habitat) and 3.1 acres of intertidal and shallow subtidal habitat. In its evaluation of aquatic impacts in the Substantive Compliance document, the EPA rated the St. Paul Waterway as high/high and Blair Slip 1 as medium/high. This loss will require mitigation at some unknown cost. In contrast, the Mouth of Hylebos CAD was rated as medium/low. Rather than requiring mitigation, it is expected to constitute an environmental enhancement. Actions such as environmental enhancement are strongly encouraged by the Supplementary Information for the 404(b)(1) Guidelines at FR 45, No. 248, page 85336. The loss of habitat and subsequent mitigation can be avoided by the use of the Mouth of Hylebos CAD as the single disposal site. [89]

***Response 138:** See Responses 136 and 137.*

Comment 139: The use of fewer disposal sites is not only less impactive to Commencement Bay, it also may result in a substantially lower cost of cleanup. For Hylebos Waterway alone, the cost of using Mouth of Hylebos as a single disposal site is $7 million to $14 million less expensive than using two disposal sites based on current cost estimates. Incorporating sediment from other problem areas could further reduce the overall cost for cleanup of Commencement Bay sediments by building economies of scale. Therefore the ESD's recommended cleanup does not meet the CERCLA criteria for cost effectiveness because it is not the least cost, fully protective alternative. In addition, these costs do not include the unknown cost of mitigation which will be required at two of the sites. The use of the Mouth of the Hylebos CAD alone will be less costly and will avoid the costs of mitigation.[89][150]

One of the commentors also stated that in 1988, the Corps revised a portion of its dredging regulations at 33 CFR Parts 209, 335-338. In this revision the Corps developed the concept of the Federal Standard. As defined at 33 CFR 335.7, (the) "Federal Standard means the dredged material disposal alternative or alternatives identified by the Corps which represent the least costly alternatives consistent with sound engineering practices and meeting the environmental standards established by the 404(b)(1) evaluation process or the ocean dumping criteria."

Legally, the Federal Standard is applicable only to the Corps when undertaking operation and maintenance activities at Army Civil Works projects. Thus, it is not legally applicable to the Commencement Bay remediation project. It is, however, generically applicable to any dredged material disposal project and has been widely used as a basic principle in the planning and design of dredged material disposal activities. This being the case, if it is applied to the Commencement Bay remediation project it is seen that the project fails two of the three components of the Federal Standard, economic and environmental. [89]

Response 139: *EPA agrees that the Corps' regulations for operation and maintenance activities at Army Civil Works projects are not applicable or relevant and appropriate to apply at the CB/NT site. The CERCLA criteria for determining suitable cost directs EPA to select remedies where costs are proportional to overall effectiveness, 40 CFR §300.430(f)(1)(ii)(D). However, cost is not the only test of alternative suitability. EPA balances cost with several other criteria in the both the CERCLA and 404 alternatives analyses. Nonetheless, as discussed in Response 136, the Mouth of Hylebos CAD is not available. In addition, EPA does not concur that the CAD at the Mouth of the Hylebos Waterway would necessarily require no mitigation. Some aquatic habitat would still be lost or modified. Mitigation measures would still be required to minimize and/or offset any unavoidable impacts to the aquatic environment.*

Comment 140:. The draft ESD recommends disposal sites that are not yet known to be available or implementable. The draft ESD states there is currently much uncertainty associated with mitigation that might be requested by NMFS and USFWS under the ESA—for example a diversion of Puyallup River water to Middle Waterway as part of the mitigation for St. Paul Waterway nearshore fill, or expanded mitigation for the Blair Slip 1 nearshore fill. Furthermore, EPA has not determined if all three of the sites are available or if there will be any costs involved in using the sites. Consequently, contrary to the NCP, there has not yet been a full and complete "feasibility study level" delineation of mitigation scope, performance or cost in the draft ESD, nor a complete evaluation of the nine CERCLA criteria. [150]

Response 140: *The selected disposal sites in the final ESD, as demonstrated by the 404(b)(1) evaluation are practicable, thus, available. Throughout the conceptual development of the disposal sites, EPA required extensive demonstration that impacts at these sites would not cause or contribute to significant degradation of the waters of the United States. Throughout pre-remedial design planning, EPA identified all appropriate and practicable steps to avoid short- and long-term unacceptable adverse impacts to the Commencement Bay aquatic ecosystem. All appropriate measures will be taken during remedial design, construction, and site maintenance to continue to avoid and minimize adverse impacts. Such measures that will be required by EPA include, but are not limited to, avoidance of fish-critical activity periods for in-water work, incorporation of "best-design" features and/or materials into remedial and compensatory mitigation plans that protect or enhance ESA-listed species, and creation or restoration of critical salmonid habitat. Additionally, EPA will require detailed compensatory mitigation plans to offset loss and other impacts to aquatic habitat and meet ESA responsibilities. EPA has sufficient information to finalize this ESD which approves pre-design remediation plans and selects disposal sites for contaminated sediments. EPA engaged in a thorough analysis of the remedial actions in a feasibility study to support the 1989 ROD, and several subsequent pre-design evaluations. An analysis of the nine CERCLA evaluation criteria analysis was provided in the 1989 ROD. A new nine criteria analysis is not required to address significant changes for an ESD.*

Comment 141: The EPA, in the selection of the alternatives [in the draft 404(b)(1) evaluation] indicates that mitigation will be required for Blair Slip 1 and the St. Paul Waterway sites for the lost habitat but not for the Mouth of Hylebos CAD as, with proper design, it will constitute an environmental enhancement and will be self-mitigating. It should be noted that the Guidelines do not provide for the consideration of mitigation in the selection of alternatives and the obvious spirit and intent of the Guidelines is to select sites which do not require mitigation. If this is not possible, mitigation may be considered, but only after site selection. [89]

Response 141: *EPA agrees with the commentor's statements about the role of mitigation in the 404(b)(1) evaluation and that mitigation would be required for a CAD at the Mouth of the Hylebos Waterway.*

5.3 Cleanup Criteria

Comment 142: USFWS and WDFW believe that the SQOs referenced in the ESD are outdated and not reflective of new scientific information related to acute and chronic adverse effects on biological resources, particularly fish, and may not be sufficiently protective of FWS's trust resources. They are particularly concerned that the SQOs for bioaccumulative, persistent chemicals are not sufficiently protective for fish and wildlife resources. Sediment standards and cleanup objectives in the ROD were derived and based on the protection of benthos species only, and as such, do not accurately predict protectiveness for higher order organisms. For example, recent studies on the effects of PAHs on English sole (*Pleuronectes vetulus*) indicate chemical thresholds of biological effects at levels well below traditional sediment management standards (Johnson, et al., 1994, Horness, et al., 1998). FWS and WDFW recommend that EPA conduct a thorough scientific review of recent studies on PAHs and PCBs and their related impacts to fish and shellfish and adjust, as warranted, the current SQOs to truly ensure acceptable sediment quality is achieved through the remedial actions. Failure to achieve adequate cleanup levels of contaminated sediments will further prolong injuries to aquatic resources in the Bay through continued exposure to contaminants.[28][29]

Response 142: *EPA's risk assessment and rationale for selecting cleanup levels are presented in the 1989 ROD and 1997 ESD, which concluded that the SQOs adequately protect human and ecological receptors. EPA and Ecology collected a considerable amount of sediment contamination and English sole histopathology data during remedial investigation and feasibility study (RI/FS) and considered use of these data in developing cleanup levels. EPA ultimately rejected this approach because even bottom-dwelling fish are not limited to exposure to specific areas of sediment contamination, making the relationship between the fish histopathology data and sediment contamination difficult to interpret.*

The Horness et al. (1998) paper reports on the incidence of tumors and lesions in English sole in Puget Sound and the association with sediment PAH contamination. Based on a compilation of data from various studies, the paper suggests the sediment concentrations of total PAHs greater than 2,000 ppb (dry weight) are likely to cause harmful effects on fish. These studies do not provide a direct relationship between sediment and fish health, rather this concentration is characteristic of a combination of water, sediments and prey that fish were exposed to. Selection of this concentration cannot be used as a sediment value above which harmful effects can always be expected due to the uncertainty of the actual exposure concentration and pathway. In addition, the EPA rejected a similar approach during the development of the cleanup goals because of the lack of direct association with sediment.

With regard to PCBs, EPA received similar comments to the 1997 ESD modifying the PCB cleanup level, and responded to them in the responsiveness summary (see page 46 of the 1997 ESD responsiveness summary). Since then, EPA has received no new information that would indicate that it's 1997 PCB cleanup level is not sufficiently protective of fish.

Comment 143: Several commentors believe that the revised PCB cleanup level of 300 μg/mg violates the narrative cleanup objective in the 1989 ROD, to "achieve acceptable sediment quality in a reasonable time frame." Acceptable sediment quality is defined as the absence of acute or chronic adverse effects on biological resources or significant human health risks. They believe that, in order meet the ROD criteria, EPA must reverse it's previous decision on PCB cleanup levels in Commencement Bay, changing the PCB SRAL from 450 μg/mg to 240 to 300 μg/mg and the SQO from 300 μg/mg back to the more protective cleanup level established in the original Commencement Bay ROD of 150 μg/mg. The following the specific concerns were raised about the current PCB cleanup standard:

- It dramatically increased the amount of PCB contaminated sediments to remain in Commencement Bay after Superfund cleanup was completed.
- Human and ecosystem health will be is jeopardized.
- Besides industry there are a lot of people involved in boating on the Hylebos and the Foss in marinas, who would not be sufficiently protected.
- Once the cleanup is done you can't go back and clean it up better. It should be done to the best of our ability the first time.
- Protection of human health and safety and of the ecosystem are the reasons clean water laws were passed. Citizens do not want this protection weakened.
- EPA assured that the marine and aquatic communities within Commencement Bay would continue to be adversely impacted by toxic PCB contamination for 10 to 20 years after cleanup of the waterway is conducted. [14] [30] [31] [32] [33] [34] [36] [37] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] [55] [58] [59] [60] [61] [62] [63] [64] [65] [66] [67] [68] [69] [70] [72] [74] [75] [76] [77] [78] [86] [90] [92] [155] [172] [180]

Response 143: *EPA's rationale for selecting the 300 μg/mg cleanup level, and it's response to public comments, is presented in the 1997 ESD and the Administrative Record for that decision. Since the ESD has been completed, EPA has received no new information that would indicate that the 300 μg/mg cleanup level is not sufficiently protective of human health or the environment. Based on current information, the Hylebos cleanup plan presented in this ESD will result in a post-cleanup average sediment concentration of 58 μg/mg (dry weight) in Commencement Bay (based on EPA's 7/31/00 letter to NMFS). This concentration is well below sediment effects levels that have been considered for protection of fish.*

Comment 144: The cleanup objective for the remedial actions, as described in Section 10 of the 1989-ROD, states that "the selected remedy is to achieve acceptable sediment quality in a reasonable time frame." The PRPs have delayed cleanup far beyond what could be considered a "reasonable time frame." Because of this delay, the amount of sediments requiring remediation under the original cleanup level has doubled. The increase in cost of cleaning up these sediments led the PRPs to request a revision of the cleanup standard, and in 1997, the EPA did so. [86]

Response 144: *EPA agrees that the cleanup should not be further delayed and should proceed as quickly as possible. It is logical to conclude that as long as the contamination remains exposed and unconfined, some movement of the contamination can occur through natural processes and the navigational uses of the waterways. However, delay in getting to cleanup may not be the primary reason that the amount of sediment to be cleaned up is double that estimated in the ROD. The increase in sediment volumes is more likely due to the limited number of samples taken during the RI/FS, and a more detailed modeling effort to determine areas which would naturally recover in 10 years. The ROD directed that the area and volume of sediment requiring cleanup would be better defined in remedial design, which the studies undertaken by the City and the HCC have done. Expanded sampling in pre-design showed much more area of contamination than was thought during the RI/FS. Likewise, far less area is predicted to naturally recover than was estimated in the ROD. In addition, although Ecology's source control efforts have significantly reduced the contaminant loading and input into the waterway* *over the last 10 years, many sources of sediment contamination were not controlled until several years after RI/FS samples were taken in 1984, and have likely contributed to the increase in contaminated sediment volumes.*

Comment 145: Some commentors were concerned that the revised PCB cleanup level violated the Washington State criteria established for protection of human health under MTCA; and increased the cancer risk to the Tacoma community through PCB contamination to more than 10 times the risk permitted under Washington State law.[39] [67] [86]

Response 145: *The PCB cleanup level is in compliance with Washington State Law, as discussed in the 1997 ESD. In addition, Ecology concurred with the 1997 ESD.*

Comment 146: Several commentors raised concerns that the amended PCB cleanup level is not protective of juvenile salmonids, which have been listed as threatened under the ESA since EPA's 1997 decision to raise the PCB cleanup level. They noted that the salmon migrate through the Hylebos Waterway to reach Hylebos Creek and that salmon using the Hylebos Waterway for feeding and rearing will continue to be harmed by the concentration of PCBs left in the sediments of the waterway. CHB and People for Puget Sound noted that studies completed by NMFS science staff has established that a pathway to PCB exposure does exist and have also demonstrated an effect to juvenile salmon exposed to PCB in the Hylebos Waterway. Some commentors noted that NMFS has established that PCB levels in excess of 200 μg/mg have been demonstrated to impair the health of juvenile salmonids and increase their susceptibility to disease, while others commented that these findings will be confirmed in the near future when NMFS releases its white paper on the PCB study. Commentors believe that unless the PCB cleanup standard is revised to reflect decisions in the 1989 ROD, this cleanup will obviously fail to protect human health and juvenile salmon, as well as all other fish and wildlife. This may fit the definition of "take" under the ESA.[36][39][86] [180]

NOAA commented that its staff are currently re-assessing the cleanup levels for the site, as defined in the 1989 ROD and the 1997 ESD, which modified the PCB cleanup level. NOAA is not convinced that the cleanup levels selected by EPA will protect NOAA trust resources, including chinook salmon. Because they are not discussed in the ESD, they did not provide specific comments on cleanup levels at this time, but want to make it clear that despite their generally favorable review of the ESD, they consider cleanup levels to be an issue open for continued discussion. [81]

Response 146: *See Response 143. EPA considers it essential to keep the cleanup process moving forward and to continue to make decisions based on available information. EPA has been in close contact with NOAA on this issue and understand that they are developing information that will undergo peer review in the near future. If NOAA submits its analysis to EPA and if NOAA's recommendation is that the current cleanup level should be changed, EPA at that time will determine whether a change to the PCB cleanup level is appropriate.*

Comment 147: USFWS noted that PCB levels at the site were generally estimated using Aroclor mixtures. Since PCB congeners have different potency factors (toxic equivalency factors) and elicit different responses on biological receptors, they believe it is essential for EPA to conduct congener specific analysis when determining risk to ecological receptors. [29]

Response 147: *The commentor is correct that EPA used Aroclor mixtures to measure and evaluate risks posed by PCB concentrations at the site. Congener-specific analysis is becoming an important component in new PCB risk assessments, and is becoming more accepted as a way to address risks that may not be addressed using the Aroclor approach. EPA is still in the process of developing guidance on measurement of congeners and on assessing risks posed by dioxin-like PCB congeners to human health and environment. However, EPA has decided that the delay to cleanup that would be caused by going back to old sites like CB/NT, where hundreds* *of samples were tested using the Aroclor approach, and collecting new congener-specific data, would result in greater harm to human health and the environment than going forward with the cleanup using Aroclor data.*

Comment 148: The Ecology trustee representative commented that until cleanup and trustee objectives are met, institutional controls and natural recovery do not protect, but instead incur, ongoing injury to natural resources.[85]

Response 148: *The ROD and the Administrative Record, including ESDs, support EPA's determination that the remedy selected is protective of human health and the environment in compliance with CERCLA, the NCP, and EPA guidance. Natural recovery, in principle, allows contamination slightly higher than the SQOs to remain in the environment for a period of time to allow natural processes to degrade the contaminants to achieve the SQOs within 10 years of the beginning of cleanup. It is acknowledged that some ongoing natural resource injury may occur until the SQOs are achieved. However, EPA determined that the potential effects from allowing marginally contaminated areas to naturally recover was offset by the avoidance of impacts dredging can have on existing habitat and marine organisms.*

Comment 149: The City has questioned the validity of the BEP cleanup level for the Thea Foss Waterway. They cited a recent literature compilation of toxicity studies involving phthalate esters (Staples et al., 1997), where investigators found that high molecular weight phthalates such as BEP exceeded their solubility limit before toxic concentrations could be achieved in water. In addition, the City cited the results of their own toxicity study where three different types of organisms (adult amphipods, larval echinoderms, and juvenile polychaetes) were exposed to field collected sediments that had been mixed with clean sediments to achieve a range of sediment concentrations. In that study, significant toxicity (according to SMS criteria)was observed only at BEP concentrations above 5,300 µg/mg. (4 times the SQO). The City feels that the toxicity presently observed in the waterway is likely due to co-occurring chemicals such as PAHs and mercury, rather than BEP. Based on this, the City is requesting that DMMP guidelines (the screening level for open-water disposal is 8,300 µg/mg) be considered for management of BEP recontamination that has been predicted and that biological monitoring be relied upon to determine the significance of any post-remedial action BEP exceedances in the sediment.[156]

Response 149: *EPA has agreed that biological monitoring will play an important role in determining the ecological significance of BEP recontamination. Based on EPA's evaluation of the Round 2 biological data from Thea Foss Waterway SSMAs 2,3, 4, and 5 along with the Round 3 BEP laboratory toxicity study, EPA thinks that if a site-specific BEP criterion was developed, it would still be of the same order of magnitude as the SQO. As an example, if the amphipod results from the toxicity study were compared to controls (due to the high mortalities in the reference samples), significant toxicity occurred above 2,000 µg/mg BEP. Significant toxicity also occurred for combined echinoderm larval abnormality and mortality above 2,900 µg/mg . However, EPA intends to include biological monitoring and testing as a major component of the Operations, Maintenance and Monitoring Plan (OMMP) to be implement after the remedial action is completed.*

5.4 Performance Criteria

Comment 150: We are concerned that the cleanup plans for both the Thea Foss and Hylebos waterways call for dredging and capping in adjacent sediment management units, with resulting final elevations that are significantly different from one another. EPA should take special care during the design phase to ensure that differing elevations throughout a waterway do not result in slumping of capped areas into dredged areas, re-exposing or spreading contaminants through the waterway. [81]

Response 150: *EPA will require for the final design full assurance through performance and long-term monitoring to ensure that slumping of capped areas will not occur and that there are measures taken to ensure adequate protection from exposure or spreading of contaminants. Project stability is critical to the long-term effectiveness of any cleanup action.*

5.5 Natural Recovery

Comment 151: The Tribe feels very strongly that natural recovery is not applicable to remediation of the Hylebos Waterway, an active, industrial waterway where low levels of sedimentation will be disturbed by propellor scour, wave action, in-water construction and maintenance, dredging or other in-water activities. The Tribe further feels that natural recovery is neither protective nor a reliable component of the remedy for Commencement Bay cleanups and are concerned that a failure of natural recovery will result in further natural resource injuries, greater cost, longer duration before cleanup goals are met, and will likely require development of another disposal site in the bay.[56]

Both the USFWS and the WDFW are concerned with the potential lack of protectiveness of natural recovery in the context of the bay-wide cleanup. WDFW included enhanced natural recovery in that same concern. USFWS was particularly concerned about using natural recovery for bioaccumulative contaminants such as PCBs and mercury. Overall, these resource management agencies do not believe that natural recovery should be applied in Commencement Bay. However, if EPA chooses to include natural recovery as part of the remedy, then the resource agencies requested that an adaptive management plan be pursued, at a minimum, if natural recovery is implemented and that the plan include extensive monitoring to evaluate natural recovery effectiveness prior to the 10-year time frame and identification of appropriate contingencies if natural recovery fails to achieve the remediation goals. [28] [29]

In past reviews, NOAA has documented specific technical concerns with the estimation of sedimentation used by the HCC to predict natural recovery rates in the Hylebos Waterway. NOAA continues to contend that natural recovery will not occur as predicted in this waterway. NOAA is requesting that if there is some uncertainty as to the effectiveness of natural recovery at a particular location that EPA take a conservative approach and require active remediation now. NOAA is concerned that if additional cleanup may be required it will further disrupt the benthic community and, in general, have an unfavorable outcome. [81]

The public also had the expectation that natural recovery would have occurred by now if it was going to be effective. [82]

Natural recovery for PAHs in the Thea Foss Waterway was questioned by some commentors because of the outstanding disagreement with the City regarding the fate of PAHs in storm water. The City currently contends that PAHs are maintained in a dissolved state and do not readily partition to sediment due to the low levels of suspended particulate material. Thus storm water is considered by the City to have little impact on natural recovery or recontamination for PAHs. Some reviewers disagree that suspended material is limited. This affects the outcome of the recontamination potential in that PAHs may be subject to much slower rates of recovery if the input (sediment load) is greater than anticipated. One commentor suggested that additional review of the fate and transport of PAHs be examined prior to design.[151]

Although the CHB do not agree with the use of natural recovery in Commencement Bay, they recognize that it will be implemented as the remedy for some areas. They requested that EPA implement performance objectives for natural recovery areas with clear triggers for when contingency actions are required. They want a plan that will identify the frequency and timing of monitoring, triggers for contingency actions, timing of when natural recovery will be considered no longer viable, and consequences for the PRPs if they do not follow through. [39]

Response 151: *Natural recovery was determined in the ROD to be an appropriate remedy for marginally contaminated areas that are predicted to recover naturally within 10 years of sediment remedial action. Natural recovery was not anticipated to begin to occur until all sources were controlled and highly contaminated sediments were confined. About 20 acres are predicted to naturally recover out of the 120 acres that require remediation in Hylebos Waterway. In the Thea Foss Waterway, approximately 20 acres are predicted to naturally recover out of 80 acres that require remediation. An additional 4 acres in the Thea Foss Waterway will be subject to enhanced natural recovery by adding a thin layer of clean material to the sediment.*

Because of the limited use of natural recovery, minimal risk exists for exposure of mobile aquatic biota to bioaccumulative contaminants undergoing natural recovery. In addition, contaminant concentrations are low (typically between 1 to 3 times the SQO,). The majority of the locations in Thea Foss that will be allowed to naturally recover are contaminated with bis(2-ethylhexyl)phthalate and typically exhibited only minor adverse effects. Areas in Hylebos Waterway that will be allowed to naturally recover are contaminated with various chlorinated organics, including PCBs. Natural recovery areas were designated as such if biological test failures were below the minor adverse effects range in Hylebos Waterway. The exception to this was that areas with PCBs were not allowed to use bioassays to refute the need for remediation and exceedances were limited to 1.5 times the SQO (i.e., 450 μg/mg) for natural recovery designations. Based on the recovery factors calculated in the Hylebos Round 1 Data Evaluation Report, a number of locations contaminated with PCBs will undergo natural recovery in less than 10 years (e.g., 2 to 5 years).

Because natural recovery is predicted based on various models that inherently have some uncertainty associated with them, EPA will rely on monitoring during the recovery period to determine if natural recovery is actually occurring at the rate necessary to achieve recovery in the 10-year period following sediment remediation. Contingency actions and triggers for those actions will be identified in the Operation Management and Monitoring Plan (OMMP) for each waterway to address additional cleanup should natural recovery fail or not be achieved within 10 years. Those contingent actions could result in implementation of active remediation before the 10-year period has lapsed, if warranted. In addition, the OMMP will include a monitoring plan for the natural recovery areas, including enhanced natural recovery areas, that includes the type, frequency, and timing of such activities.

Comment 152: One member of the public asked for clarification of the enhanced natural recovery, as it appeared to be a thin-layer cap. The commentor raised the concern that this approach appeared deceptive and that it looked like a short cut for the City in an area that should probably be actively remediated. [82]

The CHB recommended that excess clean material excavated from the St. Paul Waterway be used to enhance natural recovery processes in areas currently designated for this remedial option. [39]

Response 152: *Enhanced natural recovery is not intended to confine sediment, rather it relies upon biological and physical processes to mix a thin (6 to 12 inches) layer of clean sediment with underlying marginally contaminated sediment to expedite reaching sediment cleanup goals in 10 years. Enhanced natural recovery is not a short cut for any party because it will be monitored to the same degree as other natural recovery areas and remediation will be required if SQOs are not achieved in 10 years. Material used for enhancing natural recovery will need to meet the sediment quality objectives. The material excavated from the St. Paul would qualify and may be available for capping or enhanced natural recovery. The amount of material available for beneficial reuse will be determined during construction of the St. Paul disposal facility.*

Comment 153: The City concurs with EPA's requirement for long-term monitoring to confirm the effectiveness of natural recovery and the need for active sediment remediation if monitoring indicates natural recovery is not viable within a reasonable time frame, which is specified in the ROD as ten years. The City also recognizes EPA's inclusion of enhanced natural recovery as a component of the remedy and has designated this remedy for portions of some SSMAs, as discussed below in the SSMA-specific subsections. [156]

Occidental agrees with the ESD's conclusion at page 19 that, at this time, sediment within and in front of the Chinook Marina (SMA 501) and an area near the 11th Street Bridge (SMA 502) are appropriate for natural recovery under EPA criteria. [148]. Occidental further agrees with the ESD's conclusion that "enhanced natural recovery" is appropriate and consistent with the ROD remedy. [148]

***Response 153:** Comments noted.*

Comment 154: The PCW is concerned that the draft ESD fundamentally changed the definition of natural recovery, resulting in near elimination of natural recovery as part of the remedy. The ROD estimated that 57 percent of the areas exceeding SQOs in the waterway would recover naturally, whereas the draft ESD applies natural recovery to only 17 percent of the Hylebos Waterway areas that require remediation. It is the opinion of the Partnership that this represents a fundamental change in the scope of application of natural recovery and requires a ROD amendment and evaluation of the nine CERCLA criteria in order to comply with the NCP. On the other hand, they feel that WRDA environmental dredging could cleanup the natural recovery sediment without any changes to the existing ROD. [150]

***Response 154:** EPA's designation of natural recovery areas in the ESD is consistent with the 1989 ROD. The cleanup objective stated in the ROD is "acceptable sediment quality in a reasonable timeframe." (See Sections 10.1, 10.2.3 and 10.2.4 of the ROD). As stated in the ROD, natural recovery was to be applied to marginally contaminated areas where recovery can occur in a reasonable time period after source control and sediment remediation are completed. However, in more heavily contaminated areas, the predicted persistence of significant adverse impacts over long periods of time outweighs the potential short-term impacts from active remediation; therefore, as stated in the ROD and the Responsiveness Summary for the ROD, sediment remediation is warranted in order to be adequately protective of human health and the environment. Estimates of natural recovery in the ROD were based on limited data collected as part of the feasibility study. The ROD anticipated that natural recovery estimates would be refined as the result of additional source investigations, sediment sampling conducted as part of remedial design, and emerging information regarding recovery processes . See Sections 8.2.3 and 10.2.4 of the ROD. Additionally, the ROD stated that results of the sediment sampling during the remedial design phase would refine estimate of the areal extent and depth of contamination to be addressed by the sediment remedial alternative. See Section 10.2.4. of the ROD. Information gathered during pre-remedial design studies show that natural recovery is not predicted to occur in as many areas as originally determined. For a response to whether a ROD amendment or ESD is appropriate for documenting this decision, see response to Comment 40.*

5.6 ARARs

Comment 155: USFWS commented that the draft ESD accurately identifies the need to protect federally-listed endangered, threatened or proposed species under the ESA , but incorrectly identifies the ESA as an ARAR under the original ROD. USFWS and NOAA further commented that the ESA is a "stand alone" statute and was not included as an ARAR in the ROD. USFWS recognized the fact that EPA is in the process of consulting with the USFWS and the NMFS on potential impacts to federally-listed species and their habitats, and reminds EPA that adjustments to current mitigation and remedial action plans may result from the consultation. USFWS further commented that it supported the current comprehensive, bay-wide approach to EPA's impacts analysis. [29][81]

Another commentor noted their belief that protection of endangered species will not be achieved by the proposed remedial action. The combination of dredging, capping, natural recovery and conversion of intertidal habitat to subtidal habitat will be difficult to evaluate under ESA. Consultation with the appropriate agencies may result in adjustments to remedial design as well as mitigation plans. [56]

Response 155: *The final ESD identifies the ESA as an ARAR for remedial actions taken in accordance with the CBN/T ROD. The 1989 ROD did not list ESA as an ARAR because at that time there were no listed species that was determined to be affected by the remedial action. On March 24, 1999, NMFS listed as threatened the Puget Sound chinook salmon in Washington. On November 1, 1999 the USFWS listed bull trout as a threatened species. Under CERCLA Section 121(d), 42 U.S.C. 9621(d), other environmental laws are complied with as ARARs. When a requirement is an ARAR, it means that EPA determines compliance with substantive requirements, but does not necessarily comply with procedural requirements. EPA's national policy on the ESA strongly recommends that we consult with the appropriate resource agency, which we are doing for Commencement Bay. EPA has submitted it's biological assessment to both USFWS and NMFS. Our biological assessment concluded that a few components of the remedial actions may likely adversely affect critical habitat, and mitigative measures have been incorporated so that the remedial actions contained in the ESD will not jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of a critical habitat.*

Comment 156: NOAA and the Tribe noted that where remedial actions cause adverse impacts (during cleanup or disposal), mitigation for lost natural resources or their services is required. As a specific example, it was noted that objectives for the Hylebos Waterway intertidal cleanup should be expanded to include adequate compensatory mitigation; and ESA compliance. [56][81]

Response 156: *EPA agrees. Based on available information, the impacts from the cleanup plans for each waterway and proposed disposal sites have been evaluated for compliance with Section 404 of the Clean Water Act. Throughout remedial design, EPA will require that impacts are avoided and minimized, and any unavoidable adverse impacts as a result of the cleanup be compensated for by adequate compensatory mitigation. As discussed in response to Comment 155, EPA has conducted a biological assessment of the remedial action and will continue to evaluate ongoing ESA compliance in consultation with USFWS and NMFS as the design plans are prepared and more detail becomes available.*

Comment 157. The Mouth of Hylebos CAD site is identified in EPA supplementary documents as being in the S-12 shoreline area, therefore the CAD site is consistent with the Tacoma Shoreline Master Program and therefore SMA, an ARAR for this site. The CAD site is expandable to 33 acres. Won't the expansion push the site further into the S-13, which is not an urban environment but a conservancy environment where CAD's are not allowed? If the CAD site cannot be fully contained within the S-12, where, when, and how will EPA look for a new site? Or is it the intention of EPA to request a waiver of state law to place the CAD site at the Mouth of Hylebos location? [82]

Response 157: *See Response 1 for EPA's decision regarding use of the Hylebos CAD site.*

Comment 158: The Tribe also disagrees with EPA that the cleanup plan complies with Tribal ARARS. Changing the PCB cleanup level under a previous ESD was completely contrary to the goals of the Settlement Agreement of 1989 and continues to jeopardize the health safety and welfare of Tribal members and the natural resources upon which they rely for subsistence and spiritual and cultural use. [56]

Response 158: *There is no tribal standard for PCBs in marine sediments. In the absence of a promulgated standard, EPA conducted a human health and ecological risk assessment. The current PCB cleanup standard (a sediment remedial action level of 450 ppb, and an SQO of 300 ppb) were established in the 1997 ESD. These standards were based on a "high end" tribal fishing scenario and ecological risk assessment for the CB/NT site. As explained in EPA's 1997 ESD (see Section III), EPA believes that the cleanup standard for PCBs will result in substantial reduction in risk and be protective of human health and the environment.*

5.7 Institutional Controls

Comment 159: A number of diverse concerns were raised regarding the use of institutional controls as part of the remedy were raised. Members of the community stated a strong desire to have institutional controls (including deed restrictions) "firmly established in perpetuity to avoid future abatement or elimination from political or economic pressures that may not favor environmental quality or human health." [39] As an example, members of the community felt that institutional controls should be in-place to prevent damage to the surface of the subtidal disposal facilities [12]. However, some forms of institutional controls, such as fishing or seafood consumption advisories, were not seen as appropriate for long-term use. The public felt that the ultimate goal should be unrestricted water use. [39] NOAA also stated that use of fishing or seafood consumption advisories may constitute an on-going natural resource injury. [81]

Response 159: *Fish consumption advisories will continue to be necessary for a period of time after sediment cleanup to protect human health based on ingestion of older fish that were exposed to bioaccumulative contaminants prior to the cleanup. Advisories will be in place as long as it takes for fish to either lose their contaminant body burdens or be replaced by younger fish that have not been exposed. Long-term monitoring will be used to determine the period that fish consumption advisories need to be in effect.*

To increase the long-term protectiveness of the waterway cleanups, institutional controls are required to meet the following objectives:

1. *reduce potential exposure of marine organisms to contaminated sediments disposed of and confined in aquatic disposals sites or confined by capping; and*
2. *reduce potential exposure to marine organisms to contaminated sediments left on the CB/NT site.*

One institutional control mechanism that will be used to achieve these objectives will be governmental programs that regulate dredging, filling, or other development activities in the aquatic environment. As an example, designating the area over a submerged cap as a no anchor zone for large, commercial vessels would be implemented through the Coast Guard. Generally, recreational vessels are not precluded from anchoring on a cap because their anchors are not large enough to damage a cap. Such governmental permitting programs have been in existence for many years, and are expected to continue into the future. Land use restrictions implemented through an easement or restrictive covenant is another mechanism that may be used on private property if feasible. Restrictive covenants and easements run with the land and can bind future property owners to comply with the restricted uses. CERCLA requires that five-year reviews be conducted as part of the remedy where contamination remains in place. These reviews can include a review of institutional controls.

6.0 MISCELLANEOUS COMMENTS

Comment 160: EPA's proposed decision identifies the need for clean capping material for various cleanup and disposal actions in Commencement Bay. Although Puyallup River sediments have proven suitable without adverse effects to fish and wildlife in the past, there have been concerns raised about the use of large quantities of Puyallup River sediments in the future. [71]

Response 160: *Dredging of any material from the Puyallup River would require a lease from DNR. In addition, during remedial design, EPA will review PRP proposals to obtain clean sediments for the cleanup to ensure that any removal of sediments does not adversely affect fish and wildlife, and will not be contrary to efforts to support conservation and recovery of salmonid species. EPA will also consider other sources of capping material, including clean dredged material from sources such as Slip 1 and the St. Paul disposal site, and upland borrow materials.*

Comment 161: NOAA has consistently based comments on the Commencement Bay investigations and cleanup plans on five basic principles. These are:

1. Cleanups should progress sooner rather than later to reduce continued exposure of Trust resources to contaminants.

2. A preference for complete removal of contaminants from the aquatic environment (most contaminants originated from the uplands);

3. If the aquatic environment must not continue to serve as the repository for the contaminated sediments, we prefer that contamination not be transferred from impacted waterways to otherwise clean areas for disposal;

4. Where remedial actions cause adverse impacts (during removal or disposal), mitigation for the lost natural resources or their services is required; and

5. Cleanup and disposal decisions must be made under a bay-wide planning and evaluation effort, especially for threatened or endangered Trust resources and their habitats [81]

Response 161: *In response to the first comment, EPA agrees that the cleanups should proceed as quickly as possible. As to comments 2 and 3, EPA agrees, consistent with the principals of Section 404 of the Clean Water Act, that removal of contaminated sediments from the aquatic environment is preferred, where practicable, over in-water disposal. EPA also agrees that in-water disposal in contaminated areas is preferred over disposal in clean areas. However, as discussed in EPA's 404(b)(1) analysis for the Commencement Bay cleanup, EPA has determined that in this case, complete removal of almost 2 million cy of Commencement Bay contaminated sediments from the aquatic environment is neither practicable nor in the public interest. Based on this evaluation, EPA has determined that it is appropriate to use the St. Paul Waterway, Blair Slip 1 nearshore fill sites, and an upland regional landfill for disposal of Commencement Bay contaminated sediments. NOAA's 4th and 5th comments are addressed in Responses 156 and 129, respectively.*

Comment 162: The Port and Occidental Chemical suggested that the Hylebos cleanup be broken up into manageable pieces, with cleanup of contaminated sediments north of the East 11th Street Bridge being expedited and disposed of in Slip 1. [148][154]

Response 162: *The purpose of the ESD is to describe the specific manner in which the 1989 ROD is being implemented at the Thea Foss Waterway problem areas, the Wheeler-Osgood Waterway problem area, and the two Hylebos Waterway problem areas. Additionally, the ESD is selecting disposal sites for contaminated sediment that will be dredged from all of the problem areas listed above plus the Middle Waterway problem area, and which must be confined as specified in the ROD. EPA is not specifying that a particular disposal site must be used for a particular Waterway's sediment. EPA will seek comprehensive cleanup of all problem areas consistent with the ROD as supplemented or changed by the 1997 ESD and this ESD. It is expected that future negotiations with the potentially responsible parties will determine who will implement the cleanup and how.*

Comment 163: The majority of the area at the mouth of the Blair Waterway (slip 5) which has been proposed as a mitigation site is state owned aquatic lands managed by the port under a Port Management Agreement (PMA) with DNR. Under the PMA, the Port has decision authority for infrastructure development projects. The Port is obligated to remove any improvements if the area at some time in the future becomes ineligible for inclusion within the PMA, or if the PMA expires or is canceled. Due to the statutory limitations on the management control of this site, the Port cannot unilaterally guarantee the perpetual dedication of this site for habitat mitigation. [155]

Response 163: *Comment noted. EPA will work with the Port and other potentially responsible parties to evaluate the mitigation required for impacts resulting from the dredging, disposal, or other discharge of material into waters of the United States.*

Comment 164: Occidental agrees with the designation of Slip 1 as an appropriate disposal site for dredged sediment. However, Occidental objects to the extent that the ESD and EPA purport to designate particular sediment for disposal at a particular site or sites. Furthermore, Occidental objects to the extent that the ESD and EPA purport to require that particular disposal sites (and their owners or constructors) accept or reject particular sediment (for reasons other than those appropriate under CERCLA). Depending upon the circumstances, such action by EPA could improperly interfere with private contractual rights and/or constitute a taking "without just compensation" in violation of the United States Constitution. [148]

Response 164: *See Response to Comment 162.*

7.0 ALTERNATIVE DISPOSAL OPTIONS

Comment 165: Several commentors urged EPA to transport this toxic waste to an upland facility where they can be properly stored in a dry environment. [2][3] [5] [6] [7] [8] [9] [10] [11] [13] [19] [25] [26] [91] [94] [173] [175] [176] [177] Some of the specific comments in favor of upland disposal are listed below.

It makes no rational or scientific sense to transfer contaminants from one part of the waterway to another and call that a cleanup. HCC members should be willing (or required) to remove these toxic materials completely out of the aquatic environment. They need to move the materials to a dry site where they can be confined using well-established landfill techniques. [1]

Landfill disposal, in which all of the costs of disposal would be internalized instead of borne by the public, should be strongly considered until a "multi-user disposal site" (MUDS) can be built. A multi-agency study is in progress right now that looks at several different disposal options for contaminated sediments, however, the current assessment may not include Commencement Bay sediments. [12]

We believe the landfill alternative provides the best currently available alternative for disposal of sediments from the Hylebos Waterway. We would like EPA to develop a viable landfill disposal alternative for public review. [12]

In 1989, the Commencement Bay ROD was released by the EPA. It required that all sediments removed from the bay be disposed of in the immediate area. This mandate certainly reflected the technology and options of the time since disposal sites were not in operation and sediments were not treated. But this mandate does not reflect current, tested, and available practice. The better option would be to ship the contaminated sediment to the specialized landfill in Eastern Washington. Although this would add $7 million to the cost of the Hylebos clean up, it is, in light of the extensive potential ecological damage to the north shore area of Commencement Bay, the best option. [14]

The purpose of this letter is to request the decision to use the proposed disposal site in Commencement Bay that is directly in front of my home be changed to an upland site, preferably one that does not interfere with the quality of life along a waterfront in a residential community that has been in existence for well over 100 years. [16]

I am writing to you representing our 1500 member organization to let you know that we overwhelmingly object to this plan and hope that you will reject it in favor of removing the toxic substances from the sediments in question or disposing of them in a certified upland disposal facility. [84]

The EPA has chosen not to transport the contaminated sediments to a more stable upland site such as the Roosevelt Landfill. Transportation costs are high, but could be reduced by combined rail movement with the City. The Roosevelt Landfill would be permanent and protective and does not exploit the state-owned aquatic lands by using Commencement Bay as a dumping ground. [98]

Toxic waste, after treatment, should go to a licensed industrial upland facility for proper storage for continual testing and monitoring. A they should not, as in the case of Rayonier in Pt Angeles and elsewhere around the country, go to populated areas or around natural resources.[100] [105]

The commercial entities responsible for creating this pollution originally are, if I understand the situation correctly, responsible for the cost of cleaning up and REMOVING this toxic material. It didn't come from the bay, please don't put it back there!! Why is the EPA working so hard to minimize the cost to these commercial polluters at the potential expense of our community and of the entire ecosystem in this area. This proposal makes no sense whatsoever (except for the commercial businesses which will have to pay for it) and should be abandoned in favor of upland disposal in a controlled location or other safe site, using PROVEN disposal methods. [15]

Shipping the sediments by rail to eastern Washington to a landfill has been suggested as an option. Not only would this method provide a safe repository for the fill, it would, I believe, be less costly and cumbersome than trucking it to a closer landfill. This option deserves further investigation. [101]

I strongly urge you to consider treatment, or at the very least to upland storage of this material. Without special incentives and guarantees that this project will not adversely affect our quality of life or our environment. I can not imaging myself or any of my neighbors endorsing this bogus proposal. The problem with hiding something under the rug is it usually finds it way back out. [174]

WDFW continues to support removal of contaminated sediments from Commencement Bay as the best long term solution for protection fish and wildlife resources within the Bay. As indicated above, we believe that removal, coupled with the use of treatment technologies, can provide a viable alternative to the recommended use of three separate disposal sites as proposed in the ESD. [28]

Another option should be mandated, such as upland disposal or treatment of contaminated sediments. No one can create new aquatic lands to replace those destroyed by use as a toxic waste dump on public lands. [88]

Response 165: *EPA has selected the St. Paul Waterway fill site, the Blair Slip 1 fill site, and an upland regional landfill as the three disposal sites for contaminated sediment dredged in the CB/NT site. EPA has withdrawn the Mouth of Hylebos CAD. The Hylebos CAD site was inconsistent with the coastal zone management act designation and with other unresolved issues made this site impractical to select and move forward with cleanup in a timely fashion. Contrary to some of the comments, EPA does not consider disposal in an upland regional landfill to be* *more proven or protective than a properly designed in-water disposal facility (e.g., CAD or nearshore disposal). EPA has, however, determined that it is cost-effective to dispose of contaminated sediments in an upland site.*

In remedial design, EPA will determine the volumes that require upland disposal. For example, the estimate of 300,000 cy identified for disposal in an upland regional landfill in the ESD assumes that the total volume to be dredged is 940,000 cy from the Hylebos Waterway, that Blair Slip 1 has a capacity of 640,000 cy, and that contaminated sediment from the Thea Foss and Middle waterways will be disposed of in the St. Paul Waterway. As part of the Merritt-Pardini recommendations, the Port indicated that Blair Slip1 may be expandable to 750,000 cy, and Kaiser Aluminum urged EPA to consider their property for upland disposal of approximately 100,000 cy. If one or more of these recommendations are implemented, the total volume of sediment sent to an upland regional landfill could be reduced. EPA will determine the configuration and capacity of the selected disposal locations during remedial design.

Comment 166: Some commentors suggested that EPA consider alternative in-water disposal options, including:

- A CAD facility at the head of the Hylebos Waterway, and a nearshore confined disposal facility at the end of the Hylebos/Blair peninsula [4][18][24][79] [93] [105] [106] [107] [108] [109] [110] [111] [112] [113] [114] [115] [116] [117] [118] [119] [120] [121] [122] [123] [124] [125] [126] [127] [128] [129] [130] [131] [132] [133].[134] [135] [136] [137] [138] [139] [140] [141] [142] [143] [144] [145] [146] [147]
- Deep-water disposal in Commencement Bay [36]

Response 166: *EPA considered a CAD at the head of the Hylebos Waterway and ultimately did not select it for the reasons described in the ESD. EPA also considered a nearshore fill at the head of the Hylebos/Blair peninsula. This alternative was not included in the final selection of disposal sites because of it's limited capacity, relatively high cost, and the potential loss of additional nearshore habitat. EPA did not include deep-water disposal of contaminated sediments in Commencement Bay in it's evaluation of disposal sites because deep-water disposal in Commencement Bay would occur outside of the Superfund site boundary, and would require a lengthy and involved permitting process, including DNR approval for use of state-owned aquatic lands, thus further delaying the cleanup.*

Comment 167: Several commentors supported one or both of the two nearshore confined disposal facilities proposed in the draft ESD, Blair Slip 1 and the St. Paul Waterway. [18][24][39][79] [93] [105] [106] [107] [108] [109] [110] [111] [112] [113] [114] [115] [116] [117] [118] [119] [120] [121] [122] [123] [124] [125] [126] [127] [128] [129] [130] [131] [132] [133] [134] [135] [136] [137] [138] [139] [140] [141] [142] [143] [144] [145] [146] [147] [148][154].

Response 167: *Comment noted.*

Comment 168: As previously noted, if EPA proceeds with Slip 1, it should be used to confine the highest priority sediments from the Hylebos. Such an action would provide the most immediate benefit to the public and the environment by expediting removal of the sediment of highest concern from Hylebos Waterway. That sediment, as defined by the ROD, is presented in the HCC draft Pre- Remedial Design Evaluation Report, May 1999, Figures 2-1 a, 2- 1 b, and 2-1 c. This expedited work can be conducted to meet the Port's development schedule. [150]

Response 168: *EPA agrees that Blair Slip 1 should be used for confinement of sediments designated as requiring action under Superfund. See Response 162.*

Comment 169: At the same time EPA should evaluate the option of increasing the capacity of Slip 1 by dredging out the bottom of the slip and/or increasing the height of the fill. This action has the potential to provide another 100,000 cy of storage capacity to get the maximum value from this readily implementable disposal site. The added capacity could contain other sediment that EPA considers a relative priority in Hylebos Waterway. A subsequent action could be pursued later to place the remaining lesser contaminated sediments from Hylebos Waterway into the Mouth of Hylebos site. This approach would be the most protective in that it would remove the most severely impacted sediments more quickly from the environment. It would also assure that only the least impacted dredged sediment would be placed at the Mouth of Hylebos site. [150]

Response 169: *EPA agrees that the capacity of Slip 1 should be expanded to the maximum extent practicable. See Response 162.*

7.1 Treatment Technologies

Comment 170: Several commentors believed that treatment is the best alternative for addressing for Commencement Bay contaminated sediments, and that treatment technologies were not given adequate consideration in EPA's selection process [23,28,29,100,174]. Specific concerns noted by commentors included:

- New methods of contaminated sediment treatment now exist that were not available a few years ago. DNR is sponsoring research on the availability and cost of treatment methods and should have results available by next summer. One example provided was the production of light-weight aggregate from contaminated sediments. [12]

- Treatment technologies to remove contamination from the sediments were written off too early in the selection process because they are considered to be too expensive. However the additional cost of treatment is worth it, considering the long-term uncertainties associated with confined disposal and the benefits of not having to monitor a confined disposal site forever. [23] [155] [29]

- EPA should consider approaching sediment treatment on a regional basis to achieve economies of scale in applying treatment technologies.[155]

- Sediment treatment is the only alternative that truly removes the existing contamination from the Bay and therefore avoids the uncertainty associated with leaving the contaminants in the aquatic environment for an extended period of time. At the very least, it would seem prudent that EPA strive to develop a pilot study utilizing treatment technologies for Commencement Bay sediments to fully evaluate its potential viability. [28]

Other commentors agreed with EPA's draft ESD that most treatment technologies are still in the research and development or pilot stage and, therefore, are not suitable for application to CB/NT sediments, and that confinement, rather than application of unproven and costly treatment technologies, remains the best option for addressing contaminated sediments in Commencement Bay. [57][154][148]

Response 170: *Treatment was considered, but ultimately not selected as a cleanup alternative, in the 1989 ROD. The basis for that decision may be found in the 1989 ROD, Responsiveness Summary to the ROD and the Administrative Record for the ROD. EPA reviewed current information on treatment technologies prior to issuing the draft ESD and concluded that the reasons stated in the ROD for selecting confinement over treatment are still valid. The more recent information confirms that while there have been several advances in treatment* *technologies since 1989, all current technologies evaluated would be cost-prohibitive, would cause substantial delays in the cleanup schedule to implement the technology, or have not been adequately tested to ensure their feasibility for a large-scale sediment cleanup project. EPA's disposal sites for Commencement Bay sediments were not selected solely based on cost.*

Attachment 1

CB/NT ESD RESPONSIVENESS SUMMARY

LIST OF COMMENTORS

	NAME	AFFILIATION/ADDRESS
1	(b) (6) [redacted]	
2		Tacoma, WA
3		Moses Lake, WA
4		Tacoma, WA
5		Tacoma, WA
6	(b) (6) [redacted]	Rainier Audubon Society
7	(b) (6) [redacted]	Port Townsend, WA
8		Redmond, WA
9		Tacoma, WA
10		Tacoma, WA
11		Redmond, WA
12	Mitchell, Mark Miloscia	Washington State Legislature
13	(b) (6) [redacted]	Federal Way, WA
14		Seattle, WA
15		Tacoma, WA
16		Tacoma, WA
17		Tacoma, WA
18		Tacoma, WA
19		Tacoma, WA
20	Evans, Bill	City of Tacoma, WA
21	(b) (6) [redacted]	Tacoma, WA
22		Tacoma, WA
23		Tacoma, WA
24		Tacoma, WA
25		Jill Sheldon
26	(b) (6) [redacted]	Olympic Environmental Council, Port Angeles, WA
27	(b) (6) [redacted]	Port Townsend, WA
28	Carman, Randy	Washington Department of Fish and Wildlife
29	Jackson, Gerry A.	U. S. Fish and Wildlife Service
30	(b) (6) [redacted]	Puyallup, WA
31		Tacoma WA
32		Tacoma, WA
33		Tacoma, WA
34		Vashon Island, WA
35		Tacoma, WA
36		Tacoma, WA
37		University Place, WA
38		Tacoma, WA
39	(b) (6) [redacted]	Citizens for a Healthy Bay, Tacoma, WA
40	(b) (6) [redacted]	Tacoma, WA
41		Gig Harbor, WA
42	Campbell, Tom	State Representative
43	(b) (6) [redacted]	Tacoma, WA
44		Tacoma, WA
45		University Place, WA
46		University Place, WA
47		Tacoma, WA
48		
49		Tacoma, WA
50		Tacoma, WA

51	(b) (6) [redacted]	Federal Way, WA
52	[redacted]	Tacoma, WA
53	[redacted]	Tacoma, WA
54	[redacted]	Lakewood, WA
55	[redacted]	Gig Harbor, WA
56	Puyallup Tribe of Indians	Puyallup Tribe of Indians
57	Middle Waterway Action Committee	Seattle, WA
58	(b) (6) [redacted]	Tacoma, WA
59	[redacted]	Tacoma, WA
60	[redacted]	Tacoma, WA
61	[redacted]	Tacoma, WA
62	[redacted]	Elbe, WA
63	[redacted]	Tacoma, WA
64	[redacted]	Carla Wagner
65	[redacted]	Mineral, WA
66	[redacted]	Tacoma, WA
67	(b) (6) [redacted]	Citizens for a Healthy Bay, Tacoma Washington
68	(b) (6) [redacted]	Tacoma, WA
69	[redacted]	Tacoma, WA
70	[redacted]	Auburn, WA
71	McEntee, Dave	Simpson, Seattle, WA
72	(b) (6) [redacted]	Tacoma, WA
73	[redacted]	Tacoma, WA
74	[redacted]	University Place, WA
75	Record, Sydne	University of Puget Sound, Tacoma, WA
76	Eggers, Megan	University of Puget Sound, Tacoma, WA
78	Kalbfleisch, Jerry	University of Puget Sound, Tacoma, WA
78	(b) (6) [redacted]	Tacoma, WA
79	[redacted]	Tacoma, WA
80	Smith, Dave	Washington Department of Ecology, Olympia, WA
81	(b) (6) [redacted]	National Oceanic and Atmospteric Administration, Seattle, WA
82	[redacted]	Tacoma, WA
83	[redacted]	Gig Harbor, WA
84	(b) (6) [redacted]	Tahoma Audubon Society, Tacoma, WA
85	Wilcox, Michelle	Washington Department of Ecology, Olympia, WA
	(b) (6) [redacted]	People for Puget Sound, Seattle, WA
87	Smith, Adam	Congress of the United States, Tacoma, WA
88	(b) (6) [redacted]	Tacoma, WA
89	D. Wright	Kaiser Aluminum
90	(b) (6) [redacted]	Lakewood, WA
91	(b) (6) [redacted]	Blue Mountain Audubon Society, Walla Walla, WA
92	(b) (6) [redacted]	Tacoma, WA
93	[redacted]	Sumner, WA
94	[redacted]	Port Townsend, WA
95	[redacted]	Tacoma, WA
96	[redacted]	Tacoma, WA
97	[redacted]	Tacoma, WA
98	(b) (6) [redacted]	Mangrove Action Project, Port Angeles, WA
99	(b) (6) [redacted]	Seattle, WA
100	(b) (6) [redacted]	Olympic Environmental Council, Port Angeles, WA
101	(b) (6) [redacted]	Gig Harbor, WA

102	(b) (6) [redacted]	Tacoma, WA
103	[redacted]	Tacoma, WA
104	[redacted]	
105	[redacted]	Lakewood, WA
106	[redacted]	Tacoma, WA
107	[redacted]	Tacoma, WA
108	[redacted]	Burlington, WA
109	[redacted]	Tacoma, WA .
110	[redacted]	Belfair, WA
111	[redacted]	Lacey, WA
112	[redacted]	Spanaway, WA
113	[redacted]	Kent, WA
114	[redacted]	Spanaway, WA
115	[redacted]	Tacoma, WA
116	[redacted]	Puyallup, WA
117	[redacted]	Tacoma, WA
118	[redacted]	Graham, WA
119	[redacted]	Spanaway, WA
120	[redacted]	Covington, WA
121	[redacted]	Auburn, WA
122	[redacted]	Maple Valley, WA
123	[redacted]	Auburn, WA
124	[redacted]	Lakewood, WA
125	[redacted]	Olympia, WA
126	[redacted]	Tacoma, WA
127	[redacted]	Tacoma, WA
128	[redacted]	Olympia, WA
129	[redacted]	Tacoma, WA
130	[redacted]	WA
131	[redacted]	Tacoma, WA
132	[redacted]	Puyallup, WA
133	[redacted]	Tacoma, WA
134	[redacted]	Tacoma, WA
135	[redacted]	Federal Way, WA
136	[redacted]	Tacoma, WA
137	[redacted]	Spanaway, WA
138	[redacted]	Lakewood, WA
139	[redacted]	Tacoma, WA
140	[redacted]	Spanaway, WA
141	[redacted]	Tacoma, WA
142	[redacted]	Sumner, WA
143	[redacted]	Gig Harbor, WA
144	[redacted]	Tacoma, WA
145	[redacted]	Tacoma, WA
146	[redacted]	Lakewood, WA
147	[redacted]	Tacoma, WA
148	[redacted]	Seattle, WA
149	Mitchell, Marianne	Washington State Legislature
150	Partnership for a Clean Waterway	Spokane, WA
151	Chartrand, Allan B.	ENSR for Brown, Davis, and Roberts and Woodworth and Co., Inc
152	Middle Waterway Action Committee	Seattle, WA
153	Hylebos Wood Debris Group	Tacoma, WA
154	Port of Tacoma	Tacoma, WA

155	Turley, Charles W.	Washington Department of Natural Resources
156	(b) (6)	City of Tacoma, WA
157	Graves	Kennedy/Jenks on behalf of the Intra-Participants Group
158	Dunn, Loren	Riddell Williams, P.S. for Puget Sound Energy
	Fossati, Frank R. and Ileana	
159	A. L. Rhodes	Shell Oil Company
160	(b) (6)	Tacoma, WA
161	Brackett, Gary D.	Tacoma Pierce County Chamber of Commerce
162	Madison, Bartley R.	Northwest Steelhead and Salmon Council of Trout Unlimited
163	(b) (6)	Tacoma, WA
164	McCord, Evan W.	Sewer Utility Customer Advisory Panel
165	Elrod, Tina	Agrilink Foods, Tacoma, WA
166	Metter, Sally	Wilson, Smith, Cochran and Dickerson, for J. M. Martinac Shipbuilding Corp.
167	Davis, Clark J.	Brown, Davis, and Roberts, PLLC for Eastman Chemical Company
168	Foster, William C.	William C. Foster or Danielson, Harrigan, and Tollefson, LLP for Marine Iron Works, Inc.
169	Davis, Gary W.	Sewer Utility Customer Advisory Panel, also Alpine Management, Tacoma, WA
170	Lawrence, Allen	Metro Parks of Tacoma
171	Carino, Anthony	Carino Homes
172	(b) (6)	Tacoma, WA
173		
174		
175		Tacoma, WA
176		Tacoma, WA
177		(b) (6)
178	Jacoby, Greg	for Norlund Boat
179	Dudziak, Suzanne	Port of Tacoma
180	Dalton, Matt	for Puget Sound Energy and PacificCorp Environmental Remediation Co., Tacoma, WA
181	(b) (6)	Tacoma, WA